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CONTENTS—AUGUST, 1930

VOLUME XI, No. 8

ORIGINAL ARTICLES

The Resistance of Various Tissues for Various Electric Currents . . . . . A. Bachem 391
Important Facts Concerning the Diathermy Machine and Its Current . Wilhelm Stenstrom 395
The Development and Effect of Deep-Seated Heat in the Female Pelvis . . . . . G. D. Royston; F. H. Ewerhardt; M. A. Roblee and F. B. Zener 410
Further Studies in the Problems of Obesity . . . . . Maximilian Kern 418

EDITORIALS

Last Call for Annual Session 427
New Issues for Old 428
Knighthood Conferred on Professor Leonard E. Hill 430
The Tonsil Problem Again 430

PHYSICAL THERAPY CLINICS

X-Ray Treatment of Superficial Neoplasms . . . . . W. E. Pennington 432

CURRENT NEWS AND COMMENT

Miscellaneous Items of Interest 434

THE STUDENTS' LIBRARY

Book Reviews 437

INTERNATIONAL ABSTRACTS

Abstracts of Articles on Physical Therapy, X-Ray, Radium, Biophysics and Allied Subjects . 440

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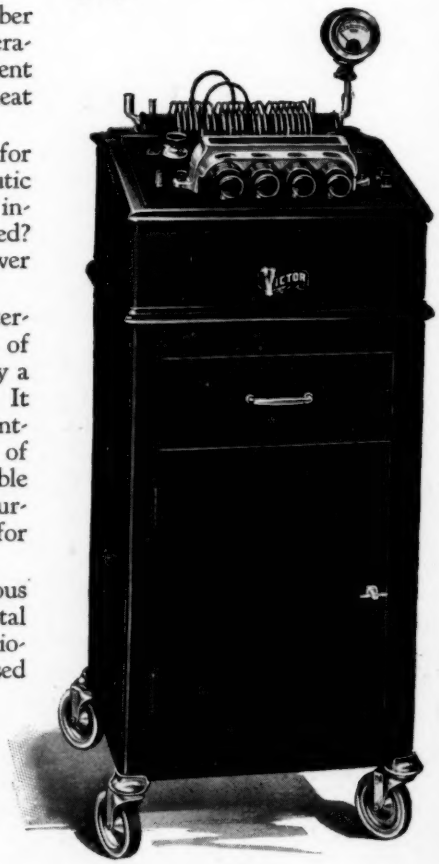

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THE RESISTANCE OF VARIOUS TISSUES FOR VARIOUS ELECTRIC CURRENTS

A. BACHEM, Ph.D.

COLLEGE OF MEDICINE, UNIVERSITY OF ILLINOIS

By the use of physical formulas one can easily show that the stationary temperature which results after sending an electric current through tissue for a considerable time depends mainly on four factors:

(a) The current intensity i.

(b) The cross-section q of the tissue penetrated by the current.

(c) The specific resistance s of the tissue.

(d) And the heat conductivity λ of the tissue.

The simplified physical formula reads:

$$t = 0.24 \frac{si^2}{\lambda q^2}$$

in which t represents the increase of temperature resulting from the current over the normal temperature. This temperature increase is in direct ratio to the specific resistance of the penetrated tissue; it is in ratio with the square of the current intensity; it is in the inverse ratio to the square of the cross-section of the penetrated tissue; and it is in inverse ratio to the heat conductivity of the tissue; the last one depends, primarily, upon the blood circulation. The importance of this factor has been demonstrated conclusively by a recent investigation in regard to the effect of electric currents upon the blood vessels.[1]

The specific resistance is of prime importance, because, in addition to determining the heating effect of a given current, it also influences the path of the current, as soon as this resistance varies over the volume of tissue in question.

According to the laws of Kirchhoff, in parallel circuits, the tissue of lower resistance will carry a stronger current, therefore overcoming the law mentioned before, and a higher temperature will result. With various resistances in series, however, the same current is forced through every part of the circuit, and the tissue with higher resistance will show higher temperature. The experimental determination of the resistance of the various tissues of the human body, as of the animal, is therefore of great importance. Wildermuth [2] conducted the first experimental work with reference to high frequency resistance. He determined the specific resistance for various organs. According to his findings, fat has the highest resistance; the brain exhibits a much smaller resistance; then lung, skin, liver and blood follow with nearly identical figures; the resistance of the intestines and muscles is still smaller; the smallest of all resistances was found for ascites. Wildermuth also determined the resistance changes with temperature and the specific heat-figures for the various tissues. All experiments, however, were made with dead tissue.

Important work was also conducted by Dowse and Iredell [3]; these authors determined the resistance of individuals to currents of various frequency, from 50 to about 10,000 cycles per second. They demonstrated a pronounced decrease of resistance with increasing frequency. Similar results have been obtained by Gildemeister, Ebbeke, Richter and others for direct and alternating currents. The explanation of this relationship has been given by the same authors, and shall not be presented in this report.

In order to throw more light upon the question of tissue resistance, I have, in collaboration with W. S. Brown, conducted a few series of measurements:

(1) Eight different organs of a dog were exposed to 3 kinds of current:

a. Direct current, 0-6V, 0-1 MA.

b. An alternating current, 0-6V, 0-1 MA, produced by an automatic commutator, about 20 periods per second.

c. High frequency current, 0-200 MA, 20-40 V. eff., 1000-2000 V. peak.

(2) These experiments were made under three different conditions:

a. In vivo, the dog being anesthetized.

b. The organs being left in position, immediately after the dog had been killed.

c. The organs removed, kept on ice for one night and then brought back to nearly room temperature.

(3) The same organs were taken from fresh bodies and exposed to the same three kinds of currents.

By these experiments could be determined:

(1) The individual resistance of each organ.

(2) The effects which are due to the special character of the current.

(3) The influence of the condition of the material—live, dead, fresh, old, etc.; special care was taken in case of the lungs (inflated, collapsed).

It is only after all these factors are determined that experiments with material from the body are of any value. The experiments were made by use of the substitution method. As normal resistance, a glass tube with solutions of 1n, 1/10n and 1/100n of potassium chloride was used, kept at a constant temperature; the same tube was used to determine the resistance of the blood. For the measurement of tissue, a double electrode was used, with 2 brass rods of 14 mm. diameter opposite one another, and with 6 mm. distance between them. They were kept in place and handled by hard rubber insulators. The tissue was placed between these brass terminals and special precaution was taken to secure good contact, and then the registration of the milliammeter was read. The voltage could be adjusted within wide limits by a slide resistance, inserted as potentiometer. The resistance was determined just by comparison with the known KCl resistance, and the specific resistance of 1 cm.^{3} tissue. The same precaution was also observed in case of skin, which is much thinner, of course, than 1 cm. The results are given in the following chart:

		SPECIFIC RESISTANCE								
Current →		HF			AC			DC		
Material	Organs	Live	Deadl	Dead 2	Live	Deadl	Dead 2	Live	Deadl	Dead 2
DOG	Liver	280	280	280	1940	3100	3000	4650	7400	9200
	Spleen	330	330	385	1530	2550	3100	4850	6900	9000
	Muscle	360	355	405	1300	1320	1600	3800	5700	7700
	Skin (shaved)	770	480	380	12100	4550	3600	25500	10600	9200
	Fat (subdermal)	2000	1950	2300	3000	3000	3300	7700	7700	9000
	Lungs (Inflated)	4300			6650			11200		
	(collapsed)	740	660	460	5600	4600	3500	10700	10600	9500
	Bone (Skull)		2400			3100			7700	
	Blood		270			300			340	
HUMAN BODY	Liver			230			1600			8000
	Spleen			230			2100			7700
	Muscle			255			1500			9000
	Skin (Dry)			435			300000			4000000
	(Wet)			435			250000			380000
	Fat			2700			3250			108000
	Lungs (Collapsed)			485			1820			5400
	Bone (tibia)			12300			15400			22500
	Kidney			200			1400			8500
	Brain			630			2170			10700

Discussion of these figures show that the resistance depends very strongly upon the current used. It is smallest for high frequency, medium for low frequency and greatest for direct current. In the latter case the resistance is by no means constant; it increases rapidly in the beginning and slowly later on. The figures in the chart were obtained after the rapid increase was over. These figures corroborate the findings of the other authors, as mentioned above.

Another result obtained is the change from live to dead tissue. In most cases there is a tendency toward an increase of resistance from life to death; the resistance is still higher after the tissue is kept on ice for a day. An exception is the skin; the resistance decreases markedly as shown in the chart in the columns of dead 1 and dead 2.

A particularly pronounced resistance change was found between the lungs, while inflated and when collapsed. The first observation was made on the inflated lungs, with the trachea ligated; then the lungs were allowed to collapse and a second reading was taken while the animal was still alive; the third reading was made immediately after the animal died. The lungs were removed, kept on ice and a fourth reading was made a day later. The drop of resistance was most pronounced at the moment of collapse; from then on there was still a noticeable decrease.

Bone and blood could be observed only after removal from the body. The blood was placed in the glass vessel, in which the normal resistances were studied, after hirudin was administered intravenously.

The figures for the human body correspond to the last column of those for the dog. In order to obtain an estimate for the live human tissues one would have to decrease the resistance in the ratio as found in the dog experiment; for skin, and particularly for the inflated lungs, the figures would have to be increased correspondingly. The brain and kidney could not be studied in the dog while the animal was alive and were therefore omitted.

A few outstanding facts from these observations are the comparatively low resistance of skin for high frequency as compared to the immense resistance toward direct current; also, that no difference occurs in case of high frequency for dry and moistened skin. The resistance of bone depends very pronouncedly upon the specimens observed; it was comparatively small for the porous bone of the skull (calvarium) and very high for the solid bone of the tibia.

Although this is a preliminary report and in no way completed, it leads to the following theoretical and practical conclusions:

(1) The study of electrical resistance should be made with live material, because pronounced changes occur in dead tissue. This hold particularly true for the collapse of the lungs.

(2) The various tissues differ so much in regard to their resistance, that the course of the electric current is affected and, therefore a great variation of heat production should be expected. This is important for the placing of the electrodes, in order to secure the desired effect on the proper organ.

(3) The skin resistance is much greater than the resistance of the average tissue for direct current; it is little greater for high frequency. From this point of view direct current seems more useful for skin cautery, while high frequency is less irritative to the skin and more useful for deep therapy.

Literature

1. Jaffe, Willis, Bachem: *Arch. of Pathology,* 1929, V, 244.

2. Wildermuth: *Mittlgn. a. d. Grenzgeb d. Med. u. Chirurg.* 1911, XXII, 511.

3. Dowse and Iredell: *Arch. of Radiol a. electrother,* 1920, 33.

Discussion

PROF. VICTOR E. LEVINE (Creighton University): Dr. Bachem always presents interesting findings. This paper has two interesting phases. One is the purely physical side and the other is the purely chemical side. I think in an investigation like this it is almost necessary to correlate the two. For example, Dr. Bachem finds that the highest resistance is in fat and subcutaneous tissue. We have some very high resistances with the liver and the other organs. I should like to see Dr. Bachem perform a series of experiments where he will determine the resistance of fat, carbohydrate and protein. I know perhaps he has that in mind, himself, because these tissues no doubt differ in their content of fat, carbohydrate and protein.

In death we see a very different phenomenon. I don't know what connection this may have with blood circulation, but I do know it probably has a connection between the protein content and the necrosis of this protein material which takes place after death, coagulation necrosis, and which con-

tinues after death. We do know, as a matter of fact, in physical chemistry, that all the constants of growth change on the application of heat, and there is a great difference whether you have heated albumin or the non-heated form.

Coagulation does take place after death and it may be of a type similar to that which takes place after the application of heat.

I have done a few experiments relative to certain physical constants like the ability to absorb acid, for example, and there is a marked change, an increase, in dead tissue in regard to its absorbing ability, and with reference to its electrolyte content.

Another interesting factor which I should like to bring out is the application. May it not be entirely possible to differentiate by means of tests such as initiated by Dr. Bachem, between dead tissue in the area of pathology, we will say, and the normal tissue? We have certain methods that are not so very good; we know that methylene-blue, for example, will color dead cells but not living cells, and methylene-blue is subject to oxidation. Expose it or reduce it in the presence of bacteria and it loses its color. There are factors which operate against the use of methylene-blue as a perfect medium.

May it not be possible that by the application of the knowledge which Dr. Bachem brings us, next year, we may differentiate for the sake of the surgeon and for the sake of the pathologist, and make a line of demarcation between living tissue and debris, sequestra, and other such things?

I wish to congratulate Dr. Bachem on the splendid papers he always presents at these conferences.

Dr. Disraeli Kobak: The problem of various resistances to high frequency currents has been in need of re-statement and reconfirmation for a very long time. An investigation of this nature is of more than academic interest. It has a practical bearing on our everyday clinical problems whenever we utilize medical diathermy. That the production of heat in the human tissue by a high frequency current is based upon Joule's law is generally accepted. According to this the quantity of heat is proportional to the strength of the current, the resistance that the current encounters and the duration of the current. There is no need to dwell upon this phase of the problem because it has been discussed by the essayist in an understanding manner.

The question whether diathermy is really a method of deep heat penetration has in recent years again been made a controversial issue by several groups of investigators in America. The interpretations based upon these studies have not always been uniform in regard to the deep heating qualities of this agency. Some of them reported totally negative effects and contradicted the earlier findings of some of the pioneer workers in the field. This has naturally thrown the entire discipline into a chaotic state. The need for some authoritative work to firmly establish again some of the recognized and fundamental actions of medical high frequency is apparent. The present contribution is therefore timely and should offset some of these destructive conclusions and the nihilism created thereby.

It is now fairly well established and generally understood that the conductivity in living material is not at all homogeneous. It differs from metallic conductors in that its conductivity is not limited to the surface. A great variety of published experiments are in existence that confirm this statement beyond peradventure.

Cumberbatch has determined this by passing a high frequency current through blocks of gelatinized conductors with fixed thermometers in the path of the current flow. Heat is produced deep within these blocks because of the resistance encountered in its passage. The body tissues also act as resistances or impedence to a diathermy current, and the heat created within its path depends upon many factors, chief amongst them being the factor of conductivity. Wildermuth, so far as we are able to determine, was the first to investigate the variable resistance of body tissue in relation to high frequency currents. This was in 1911, about eighteen years ago. Since then additional studies have been made and published by various investigators which in a general way confirmed the premises established by this author. He found fat to be of highest resistance and skin practically of lowest to the passage of a diathermic current. Muscles, mucous membranes and the body fluids were still lower in the scale of impedence.

In contra-distinction to Wildermuth's studies which dealt with dead tissues, Bachem's investigations consider three different conditions:—the resistance of tissues in vivo, an immediate check of the organs of freshly killed animals, and organs that were refrigerated and brought back to nearly room temperature within 24 hours. Two striking facts are observable; namely, that dead tissue has a higher and variable resistance than living, and that the highest resistance encountered in living material is not fat but inflated lung tissue. The later fact is explained on the basis of the presence of air pockets which act as increased impedences to the high frequency current. Collapsed lung tissue registered a sharp drop to one-sixth of the former value.

In conclusion I should like to call your attention to a few observations made by the essayist which confirms the findings of some of the earlier investigators in this field. They are:—"the comparatively low resistance of the skin for high frequency as compared to the immense resistance towards direct current," and that "no difference occurs in case of high frequency for dry and moistened skin." The physician who attempts to use diathermy in a scientific manner considers reports of this nature as an invaluable guide to his work.

Bachem: I have nothing to add to the discussion. I wish to thank both gentlemen for their generous manner of analysing my studies.

IMPORTANT FACTS CONCERNING THE DIATHERMY MACHINE AND ITS CURRENT

WILHELM STENSTROM, Ph. D.

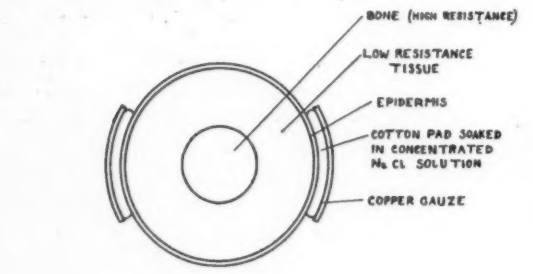
(UNIVERSITY OF MINNESOTA, MINNEAPOLIS)

The use of high frequency current to heat the body or part of the body is now usually referred to as diathermy.

Let us first compare the effects of different types of current. If a direct current is passed between two electrodes applied to the human body, positive ions are transported toward the negative electrode and negative ions toward the positive electrode. As a consequence, chemical changes are produced, and the amount of current that can be passed through the body without any untoward effect is small; rarely more than 10 milliamperes are used for treatments of this kind. If the current is reversed, the ions will move in opposite directions and nerves and muscles are stimulated. Each time the current is reversed, such a stimulation takes place. Thus an alternating current with only a few reversals per second has a very intense action on nerves and muscles, and a strong current of this type would also produce untoward effects. If the reversals are increased to 20,000 per second, making it a 10,000 cycle current, or a current of the frequency of 10,000 per second, no such stimulation is produced even when the intensity of the current is increased considerably. For reasons which will be given later, the region between 10,000 and 300,000 cycles per second is not being used in diathermy, but there is no essential difference, as far as we know, between the action of this current and of current of a frequency between 300,000 and 3,000,000, which usually is applied. The amount of current which can be used is, as a rule, determined by the size of the electrodes, and 20 milliamperes per sq. cm. of the smallest electrode has been given as an upper limit for medical diathermy. Currents as high as 3,000 milliamperes (3 amperes) are often passed through the body in this way. What is it that limits the amount of current that can be passed through with safety? Simply the heat produced in the electrical resistance of the tissues. So far, no other effect has been detected than the heat production. The possibility of direct chemical effects cannot be denied, but they seem improbable, and there is no doubt that it is the heat produced that sets a limit for the current. If greater density of current is used, then the heat coagulates the tissue, and this is made use of in surgical diathermy when one electrode is very small.

How does the high frequency current pass through the body from one electrode to the other? Let us first consider a direct current. How it travels depends entirely upon the resistances. The number of amperes passing through a resistance is equal to the potential difference, expressed in volts, between the ends of the resistance, divided by the resistance expressed in ohms ($i=\frac{v}{r}$). The energy used up is equal to the square of the current, times the resistance (i^2xr) (Joule's law). If the current can pass along two different routes from a point A to a point B, and the electrical resistance of the second route is twice as great as that of the first one, then two-thirds of the current follows the first route and one-third the second route; twice as much energy is used up in the lower resistance as in the higher. If the current can take one route only, but the first half of the route has twice as much resistance as the second half, then twice as much energy is used up in the higher resistance as in the lower. The skin has a very high electric resistance and so has the underlying fat. The current must, however, pass through these layers, and thus a considerable amount of energy is used up there. The bones also have high resistance. Very little current, however, passes through them; the main current selecting its path in the surrounding soft tissues which offer a low resistance. Due to the concentration of the current near the electrodes, and due to the high resistance at the surface, proportionately much more energy is used up at the skin surface than at any other place. When the high frequency current is considered, the above reasoning has to be modified considerably. This current is de-

pendent not upon the resistance alone, but also upon capacity and inductance. Some workers have gone so far as to state that on account of the so-called skin effect, the current does not pass through the tissues, but follows the surface; an interpretation which is altogether wrong. The skin effect is, to be sure, of importance at the frequency here referred to for metallic conductors, but it is negligible for electrolytes, and thus for tissues. The high frequency current passes through a condenser without using up any energy. The two electrodes placed opposite one another constitute a condenser in parallel with the body or the electrolyte. The capacity of this condenser is, however, in general so small that only a minute current passes across it; negligible in comparison to the current usually applied in diathermy. The electric path through an electrolyte or through the body can be represented by resistances in parallel to one another [Gildemeister (1), Einthoven (2), McClendon (3)]. (See Fig. 1.) A direct current would have to pass through all the resistances, as it cannot pass through condensers. The high frequency current passes through the series resistances, but will be divided between a resistance and a condenser which are in parallel with one another. When the resistance, the capacity and the frequency, all are very high, practically all the current passes through the condenser without producing any heat there. With a frequency of about 1,000,000 per second, we can assume for a first approximation that the current passes only through the series resistances and the condensers and we can represent the electric path through the body by a resistance in series with a condenser.



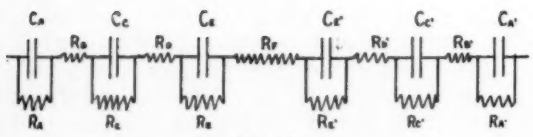


Fig. I

A series of measurements have been made in our laboratory, by Allan Hemingway (4), of resistances and capacities between the electrodes as they were applied to patients immediately before and after treatments with diathermy. A frequency of 1,000,000 per second was used for the determination of the series resistance. A quite complicated arrangement of apparatus had to be used for these measurements. A bridge method was employed. It would be going too far afield to go into details, and I will only refer to the results obtained. Depending upon locations and sizes of the electrodes, the high frequency resistance varied from 20 to 200 ohms. In order to find the magnitude of the parallel resistance and the capacity, 1000 cycle and 3000 cycle currents were used. The parallel capacity and resistance both increase as the frequency of the current decreases. This is a consequence of the polarization produced by the current. The higher the frequency, the less pronounced is the polarization. The resistance to direct current is, of course, still greater, and it is therefore evident that the high frequency resistance is only a small fraction of the direct current resistance. This is an important fact well worth remembering. I have not been able to find in the literature any previous measurements of the resistance to high frequency currents between two electrodes as applied during diathermy treatments. Without knowledge of these resistances, investigations of the efficiency of the diathermy machine are impossible. The results are gathered together in Tables I and II. I wish to call attention to some of the conclusions which can be drawn from them. The high frequency resistance is practically the same, whether pliable lead or felt electrodes, soaked in concentrated sodium chloride (neutral salt) solution are used. The low frequency values show a variation for different types of electrodes, but in diathermy practice we are not concerned with these. They illustrate, however, the necessity of taking measurements at the same frequency as that which is being used for treatments. The resistances through the trunk, e. g., the shoulder region and abdomen, are low in comparison with the re-

sistances of the joints of the limbs, which are of the order 60 to 200 ohms. The resistance of the knee with the electrodes placed one on either side, is about 60 ohms. The longitudinal resistance of the knee and ankle taken together by measuring the resistance from the thigh to the sole of the foot, is slightly less than the sum of the longitudinal resistances of knee and ankle separately as measured by large electrodes placed around the thigh and the calf and under the sole (185 ohms against 198). This is probably due, mainly, to the resistance of the skin and fat at the calf, which is included twice in the last measurements, but not at all in the first measurements. This additional resistance is small in comparison to that of the ankle (148 ohms). The high frequency resistances, r, as measured here, we assume to be the effective resistances to the high frequency current, thus causing the heat. The total amount of heat produced in the body per second should be $i^2 r$. This is a first approximation. ($0.24\ i^2 \times r \times t$ calories).

The high frequency current passes through the body in somewhat the same way as the direct current; it prefers the low resistance of the fluids and soft tissues to the high resistance and relatively low capacity of the bones. It passes the skin and underlying fat, but does not heat these structures to the same extent as the same amount of a direct current, due to the relatively large capacity effect of the epidermis. It has not been determined at what frequency the heating of the epidermis becomes negligible, but it seems evident that the higher the frequency, the smaller the amount of heat produced in this layer. The proportion of heat produced in skin and deep seated tissues should then be changed in favor of the latter as the frequency is increased. However, certain complications arise when the frequency is very high and further investigations have to be made before it can be settled which frequency would be best to use. We await with interest the results of experiments which are being carried out at different places with apparatus utilizing high radio frequency and continuous waves.

TABLE I.

Experiment No.	Locality	Electrodes	When measured	Current m. a.	High frequency series resistance ohms	High frequency series capacity F	3×10^3 cycles per second r ohms	3×10^3 cycles per second C F	10^3 cycles per second r ohms	10^3 cycles per second C F
1	Left shoulder	Lead 9x16 cm.	B	1100	28	0.05	.....	.....	705	0.590
2			A	.....	28	0.06	.....	.....	705	0.620
3	Right shoulder	"	B	1100	38.5	0.10	600	0.216	2250	0.245
4			A	.....	37.0	0.15	350	0.465	1020	0.566
5	"	"	B	1100	28.0	0.10	600	0.269	2100	0.279
6			A	.....	27.0	0.10	370	0.439	1140	0.521
7	"	"	B	1100	40.0	0.15	420	0.350	1400	0.410
8			A	.....	40.0	0.15	390	0.393	1400	0.473
9	"	"	B	1100	36.0	0.08	300	0.437	820	0.420
10			A	.....	33.0	0.09	430	0.332	850	0.370
11	Sacro iliac region	Lead 9x16 cm. Back 17x17 cm. Front	B	1000	35	0.03	250	0.722	610	0.85
12			A	.....	34	0.10	240	0.750	630	0.88
13	Right knee	Solution-soaked Felt Pad 9x6 cm.	B	500	40.0	0.05	.....	.....	1507	0.44
14			A	.....	37.0	0.05	.....	.....	2303	0.99
15	Left knee	"	B	500	33.0	0.05	.....	.....	705	0.99
16			A	.....	28.0	0.04	.....	.....	720	0.975
17	"	"	B	500	55.0	0.090	430	0.332	850	0.320
18			A	.....	45.0	0.090	338	0.415	730	0.512

TABLE II.

Experiment No.	Locality	Electrodes	When measured	Current m. a.	High frequency series resistance R	High frequency series capacity	3×10^3 cycles per second r ohms	3×10^3 cycles per second C F	10^3 cycles per second r ohms	10^3 cycles per second C F
19	Sole to thigh	Bowl of soln. Felt pad	B	500	195	0.08	193	0.245	367	0.432
20			A	.....	162	0.03	200	0.258	363	0.450
21	Thigh to calf	Felt pad	B	"	44	0.09	285	0.400	.....	.....
22			A	.....	45	0.09	290	0.410	495	0.433
23	Calf to sole	Bowl of soln. Felt pad	B	"	146	0.04	215	0.325	494	0.472
24			A	.....	133	0.10	224	0.340	490	0.474
25	Sole to thigh		B	"	197	0.06	200	0.236	370	0.413
26			A	.....	173	0.07	210	0.228	410	0.400
27	Thigh to calf		B	"	52.0	0.06	255	0.355	500	0.460
28			A	.....	47.6	0.08	280	0.370	700	0.485
29	Calf to sole		B	"	157	0.021	255	0.255	515	0.385
30			A	.....	140	0.06	255	0.280	555	0.400
31	Right shoulder	Lead 10x7 cm.	B	1000	36.0	0.07	336	0.240	800	0.355
32			A	.....	33.0	0.08	175	0.520	300	0.690
33	"	Pad electrodes 10x7 cm.	B	1000	35.5	0.08	230	0.410	450	0.610
34			A	.....	33.0	0.08	115	0.363	235	0.920
35	"	Lead electrodes 10x7 cm.	B	"	34.0	0.06	410	0.280	900	0.346
36		Pad electrodes	A	.....	33.5	0.04	217	0.392	406	0.535
37		Pad electrodes 10x7 cm.	B	.....	34.0	.....	215	0.505	785	0.715
38			A	.....	32.0	.....	120	0.760	230	1.00

The question whether the milliammeters used on the machines can be relied upon as satisfactory indicators of the heat produced in the tissues, has often been raised, but no satisfactory answer has been given. In the first place, it is evident that the total amount of heat produced is dependent upon the resistance as well as upon the current. All we could expect is that the meter reading should give information about the heat produced in a certain resistance. It might indicate approximately the heat produced per sq. cm. at the skin surface under the electrodes. However, the meter reading would be altogether unreliable as heat indicator if an appreciable part of the current passed through a condenser in parallel with the high frequency resistance referred to in Tables I and II. The condenser current would be registered on the meter without contributing to heat production. The machine then would become inefficient. It was therefore important to find out experimentally if the current registering on the meter really contributes to heat production, in agreement with Joule's law (heat produced equal to the resistance times the square of the current). Such an investigation can hardly be made with the patient in the circuit. A salt solution can be used instead to obtain similar electrical conditions. With the solution placed in a calorimeter, it is possible to measure the total amount of heat produced for a certain length of time when a certain high frequency resistance and a certain current are used. While such measurements were being made at our laboratory, d'Arsonval (5) published some results he had obtained. He found that the amount of heat produced did not increase in proportion to the resistance. He used, however, mainly much higher resistances than those in the circuit during diathermy treatment, and the values of the resistances were obtained with a low frequency current and are, therefore, not applicable to a high frequency current. Tables I and II show that

the high frequency resistances during diathermy treatments are small. For the experiments carried out by Allan Hemingway in our laboratory, the high frequency resistances were of the same magnitude. I will not discuss the experiments in detail. A number of preliminary investigations had to be carried out first. A diathermy machine of 500 kilocycles was constructed which was equipped with a Victor spark gap and meter. A sketch of the calorimeter with the electrodes and the solution is reproduced in Fig. II. The increase of temperature per minute was studied for different values of the current for resistances of approximately 75, 150, 370 and 750 ohms made up by suitable concentrations of potassium chloride. The increase was found to be proportional to the square of the current

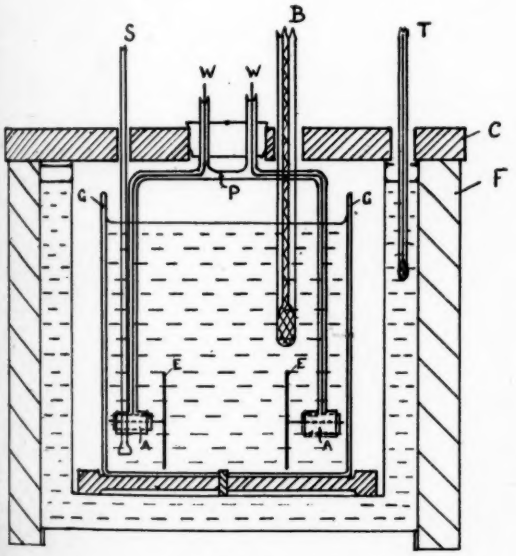


Fig. II

as is shown in the curve in Fig. III which was made for 75 ohms resistance. The other three curves show just as good agreement. It was found further that the heat produced for a given current was the same when the spark gaps and the external coupling inductance were varied, as is also illustrated in the curve in Fig. III.

Next, the 500 kilo cycle machine and a Kelley-Koett 1500 kilo cycle machine were used to study the quantitative relation between current, resistance and heat produced. A diagram of the electric circuit is given in Fig. IV. The ordinary meters supplied with the machines were checked against a Western Electric vacuum thermocouple connected to a Weston microammeter which in turn was calibrated with a direct current. They proved to be accurate enough for the precision which the fluctuations of the primary current and the spark gap permitted. Forty-five sets of measurements were made with the resistance of the potassium chloride solution between the electrodes around 20, 43, 60, 95 and 180 ohms and the current at different values between 0.45 and 0.85 amperes. The solutions were in one group of measurements arranged in parallel with all of the inductance, and in another group in parallel with one-half of the inductance. The computed values $i^2 r$ agree quite closely with the measured amount of heat given off to the solution $\frac{\Delta H}{\Delta t}$ per unit of time. For 20 ohms resistance of the solution, the measured values were slightly higher than the calculated values (on an average of 7%), whereas for 180 ohms resistance, the measured values were lower than the calculated ones (on an average of 8%). The greatest deviation for any single measurement was 19%. The heat production evidently becomes smaller and smaller in proportion to the values calculated from Joule's law as the resistances are increased. Thus d'Arsonval's measurements are not contradictory to ours, as he used much higher resistances, but they do not apply to ordinary diathermy treatments in which the high frequency resistances are low. We must further expect greater deviation from Joules law the closer together the electrodes are placed. In a calorimeter they have to be quite close together. Hemingway used a distance of 5 cm. During treatments the distance usually is much greater, though it may occasionally be smaller. Thus it seems that the meters which register the high frequency current correctly can be used as indicators for heat production at a cross section of the path of the current. This is the way it has been used, but we have felt rather uncertain about its reliability and the investigation of d'Arsonval helped discredit the milliammeter. As was mentioned before, the heat production in the different layers of tissues may be influenced by the frequency, and a certain number of milliamperes per sq. cm. of the skin may heat it more at one frequency than at another. Therefore it is possible that the skin might

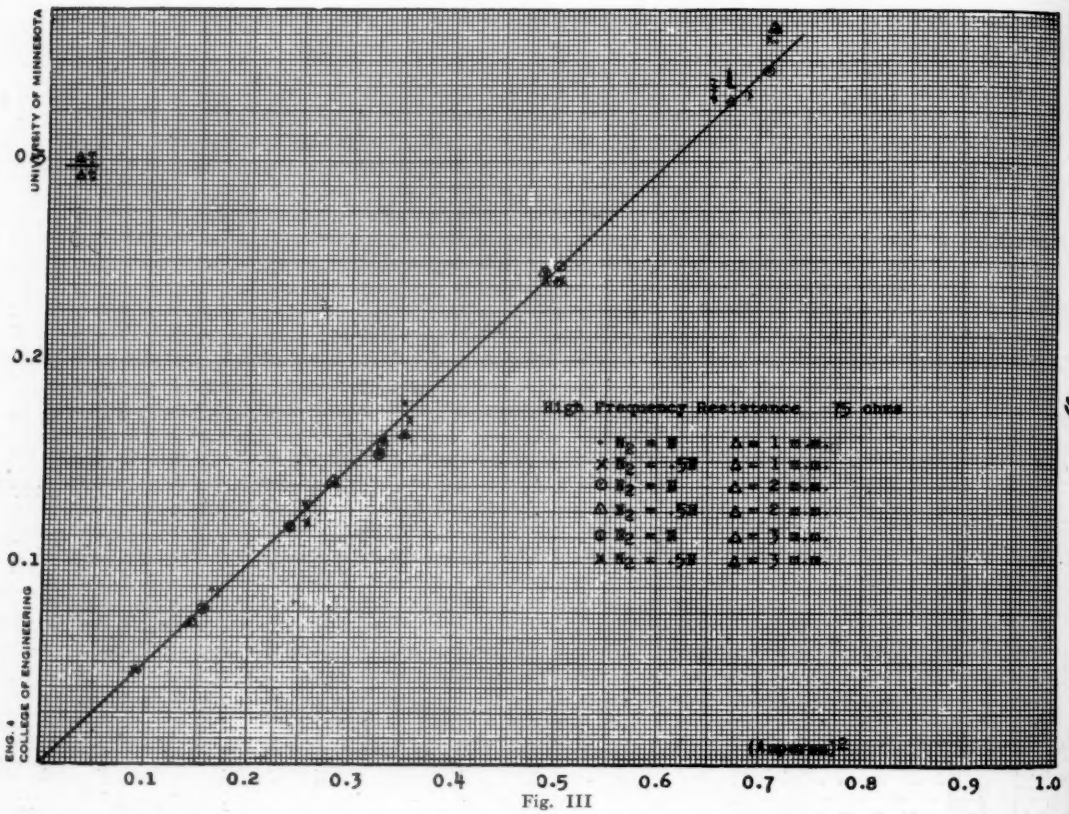


Fig. III

be heated more from one machine than from another even though the same current is used.

The determination of the frequency is, however, not as simple as it seems at first. It does not depend simply upon the machine, but also upon the outside circuit which is in parallel with all or part of the inductance of the machine. A number of frequency measurements were made by Hemingway. The curves in Figs. V and VI are selected from ten sets of curves to illustrate how the frequency changes when solutions of different resistances are coupled in. The frequency curve is rather sharp and narrow when the outside circuit is open, but it flattens out considerably when it is closed. The maximum moves further away from the value of the open circuit as the parallel resistance is reduced. The change is much smaller when the solution is in parallel with one-half of the coupling inductance than with all of it. It is evident from these results that it is necessary to measure the frequency distribution with the outside circuit closed when the effect of the frequency is studied. It is also evident that the frequency of a certain machine only gives a very approximate value of the frequency used during treatments. I do not believe it is worth while to discuss the frequency relations any further, until measurements have been made which would give more detailed information.

When d'Arsonval found that the milliammeter was not a good indicator for the heat production in high resistances, he proposed that the wattmeter might be used instead. A test of the reliability of the wattmeter for such purposes, though for lower resistances, was made by Hemingway in connection with the calorimeter measurements just described. A Weston wattmeter was connected to the primary circuit of the 500 kilo cycle machine. The relations between the wattmeter readings and the heat production, also expressed in watts, are shown in Fig. VII. It is seen that the relation is almost linear; therefore, it would seem that the wattmeter would be a good instrument to use as an indicator for

the total amount of heat produced. We must, however, remember that different machines would have different efficiencies so that the meter would have to be calibrated for the machine with which it was going to be used. The efficiency of the particular machine used for these experiments was about 50% as about 50 watts of heat were produced by 100

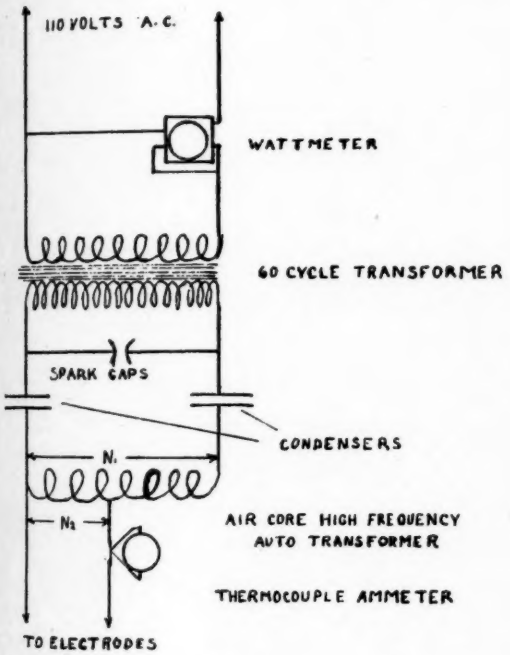


Fig. IV

watts of current. Another question is whether the efficiency of the machine is the same under all conditions. One thing that seemed of special importance to test was whether the length of the spark gap influenced the efficiency, as the current is often regulated by means of changing the gaps. The curves in Figs. VIII and IX show the change of the wattmeter readings when the current through the solution is kept constant. The change is very small when the total spark gap varies from 1 to 1.5 mm. When the gap is reduced below 1 mm. and when it is opened up above 2 mm., the required wattage goes up considerably, reducing the efficiency of the machine. Thus the wattmeter will not give a fair indication of the heat production unless the total spark gap is between 1 and 2 mm. long. The total gap was made up of four gaps in series and the measurements refer to equal spacing of these four gaps. Thus each one should be between 0.25 and 0.50 mm. wide. These results indicate that whenever diathermy treatments are given, it is important to see that the spark gaps are neither too long nor too short. The measurements shown in Fig. VII were made with a 1 mm. total gap.

Many practitioners do not rely upon the meters at all during the treatments, but increase the current slowly to the point where the patient states that the heat begins to be uncomfortable. It is, however, dangerous to go above a certain number of milliamperes per square centimeter of the smallest electrode even if the patient does not react to it. What that current is may depend upon the make of the machine. A nerve injury may reduce the heat sensitivity of the skin so that a burn may be produced before the patient feels anything.

Sometimes the current has to pass through a cross section of a limb of smaller area than the smallest electrode. In that case, the maximum current per square centimeter should be determined by this cross section. For example, when a cuff around the leg acts as one electrode and a solution under the sole as the other electrode, then the ankle is apt to be heated the most, and the maximum current should be determined by the cross section of the ankle.

Measurements by a number of investigators show that the rise of the temperature in the tissues during application of diathermy to living animals or humans is modified by several factors. The blood circulation is the most important one as has been brought out especially clearly by Binger and Christie (6). The skin under the smallest electrode or the tissues just below the skin, obtains as a rule the highest temperature. It should, however, be kept in mind that with higher frequency than what is usually used today, the conditions may change (e.g., high radio frequency) and the heating of the skin must then not be relied upon as an indicator of the dose or suitable current.

A number of measurements have been made in our laboratory, mainly by Paul Nurnberger (7), of the temperature of the skin under one electrode during ordinary treatments. The measurements were made

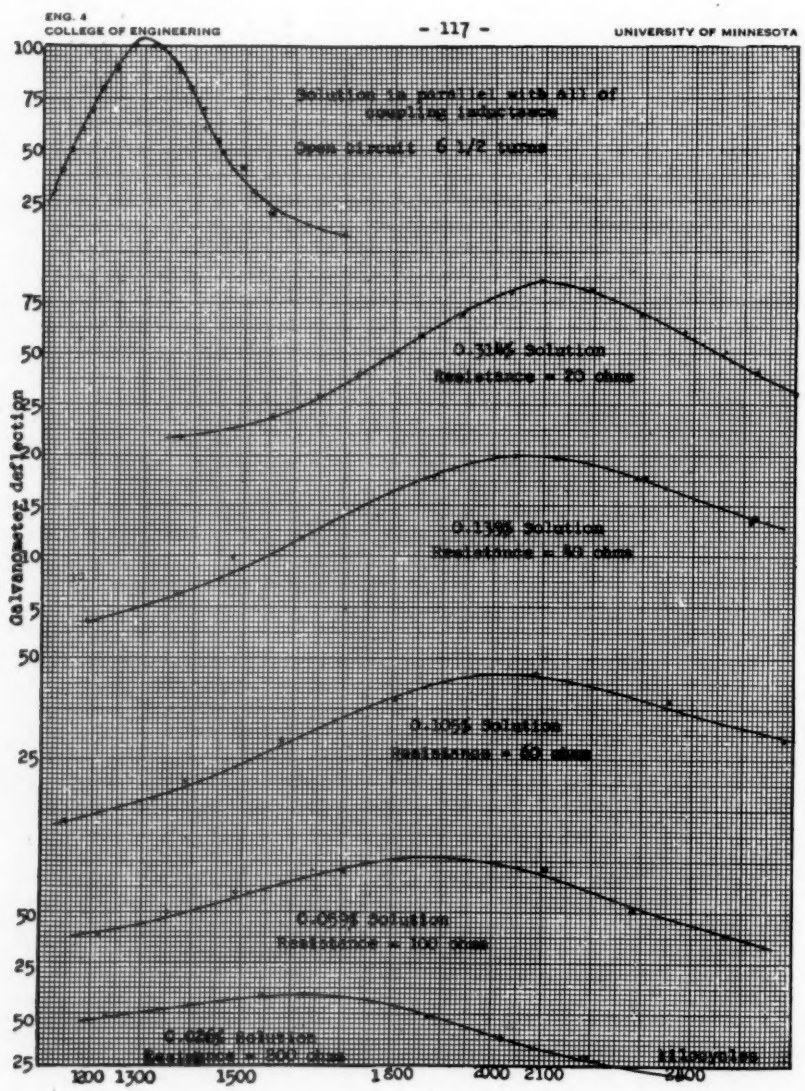


Fig. V

by means of thermocouples and a galvanometer. A Victor machine was used with such a setting that the frequency of the open circuit was about 550,000 per second. The electrodes consisted of felt soaked in a fairly concentrated NaCl solution. The sizes were: for the ankle 4x8 cm., for the knee 6x10 cm., for the back and shoulder 9x16 cm. The current was applied for 30 to 35 minutes. The temperature readings were taken at the beginning and at the end of every minute during the treatments. The results are given in Table III.

The temperature increased rapidly at the beginning of the treatment, then more slowly, and reached a maximum in from 15 to 30 minutes. It usually fell off slightly again and then reached a constant value for the rest of the treatment. From Table III it can be seen that when other factors are about the same, the skin area is heated to a higher temperature when its initial temperature is low, than when it is relatively high. This is easy to understand when it is considered that the heat transfer depends upon the circulation. The weaker the circulation in the neighborhood, the less heat is carried to a surface originally below body temperature, and the less heat is carried away from a surface heated above body temperature.

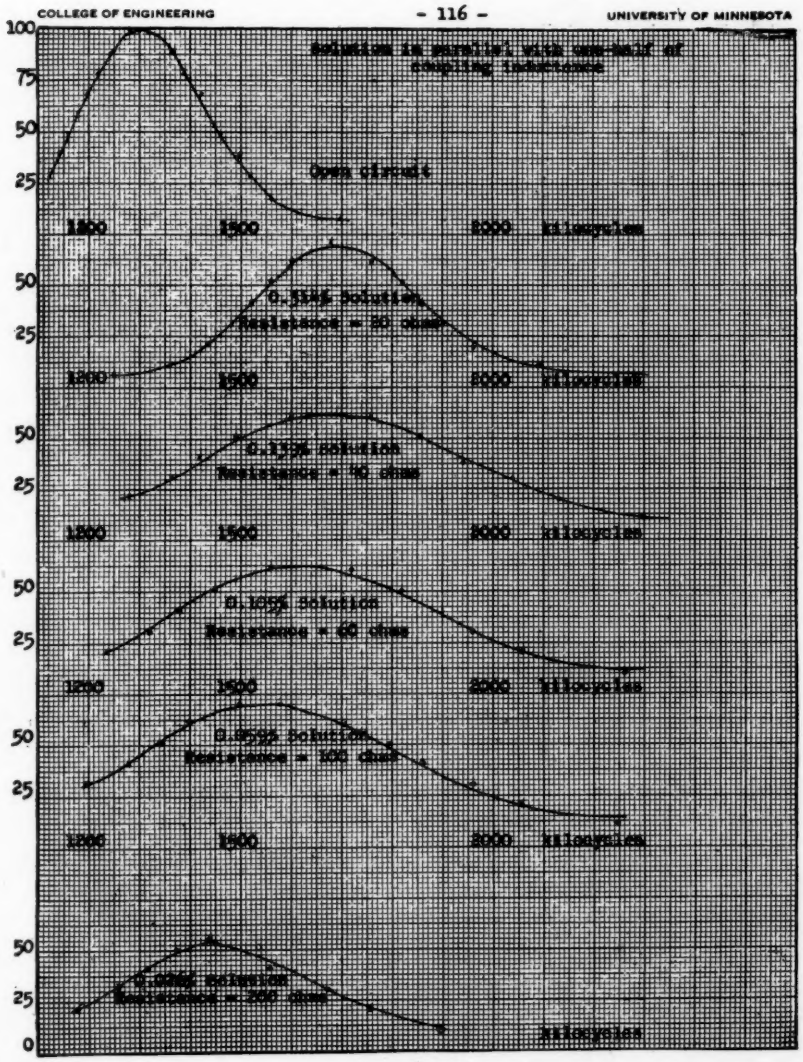


Fig. VI

The general body temperature was measured immediately before and after the treatments in 32 patients, by placing the thermocouple under the tongue of the individual. The temperature of most of the patients increased only 0.1° C. while the maximum increase was 0.85°, and the minimum 0.0° C. This is very different from the effect that Binger and Christie obtained in dogs. The difference is due somewhat to the smaller amount of heat supplied per kilogram of body weight to the patients, but probably more to the different ways in which humans and dogs regulate the body temperature.

Summary

In order that diathermy may be utilized in the best way, it is necessary that the physical problems involved are studied in detail. Some experiments have therefore been carried out in our laboratory with diathermy machines. As far as possible, the measurements have been carried out under conditions which approximate those used during the treatments of patients. Most of the experiments have been made by Allan Hemingway.

The resistances of the tissues during treatments were measured on some of the patients. The resistance to high frequency current was found to lie between 20 and 200 ohms, and

TABLE III.

Treatment No.	Patient	Location	Current M. A.	Temperature				Minute of Maximum Temperature
				Initial	Final	Maximum	Increase	
1	K.B.	R. Shoulder	1000	34.7	40.5	41.5	6.8	20
1	M.S.	R. Ankle	400	20.5	32.1	32.1	11.6	30
2	"	" "	400	23.7	29.2	29.6	5.9	30
2	M.S.	L. Ankle	400	26.3	38.1	38.3	12.0	30
1	"	" "	400	29.7	36.1	36.2	6.5	25
1	Mr. D.	R. Knee	975	29.0	43.7	44.8	15.8	32
2	" "	" "	975	30.2	43.0	43.6	13.4	33
2	M.H.	" "	950	20.7	43.0	43.6	22.9	31
1	"	" "	950	27.3	42.4	43.6	16.3	35
3	"	" "	950	28.1	38.3	38.5	10.4	25
3	C.B.	" "	975	30.8	39.7	39.7	8.9	29
1	"	" "	975	31.9	39.0	39.0	7.1	33
2	"	" "	975	32.0	40.4	40.4	8.4	33
1	L.W.	" "	1000	25.2	42.2	43.9	18.7	17
2	"	" "	1000	31.3	37.5	37.5	6.2	16
1	"	L. Knee	1000	27.0	37.0	41.4	14.4	15
3	M.S.	" "	500	24.5	46.8	48.6	24.1	22
5	"	" "	500	26.1	39.7	39.7	13.6	33
2	"	" "	500	28.0	37.7	37.7	9.7	29
4	"	" "	500	29.2	41.0	42.3	13.1	22
1	"	" "	500	29.5	43.6	43.6	14.1	31
3	"	R. Knee	500	24.4	44.5	44.7	20.3	20
5	"	" "	500	25.8	43.7	44.2	18.4	25

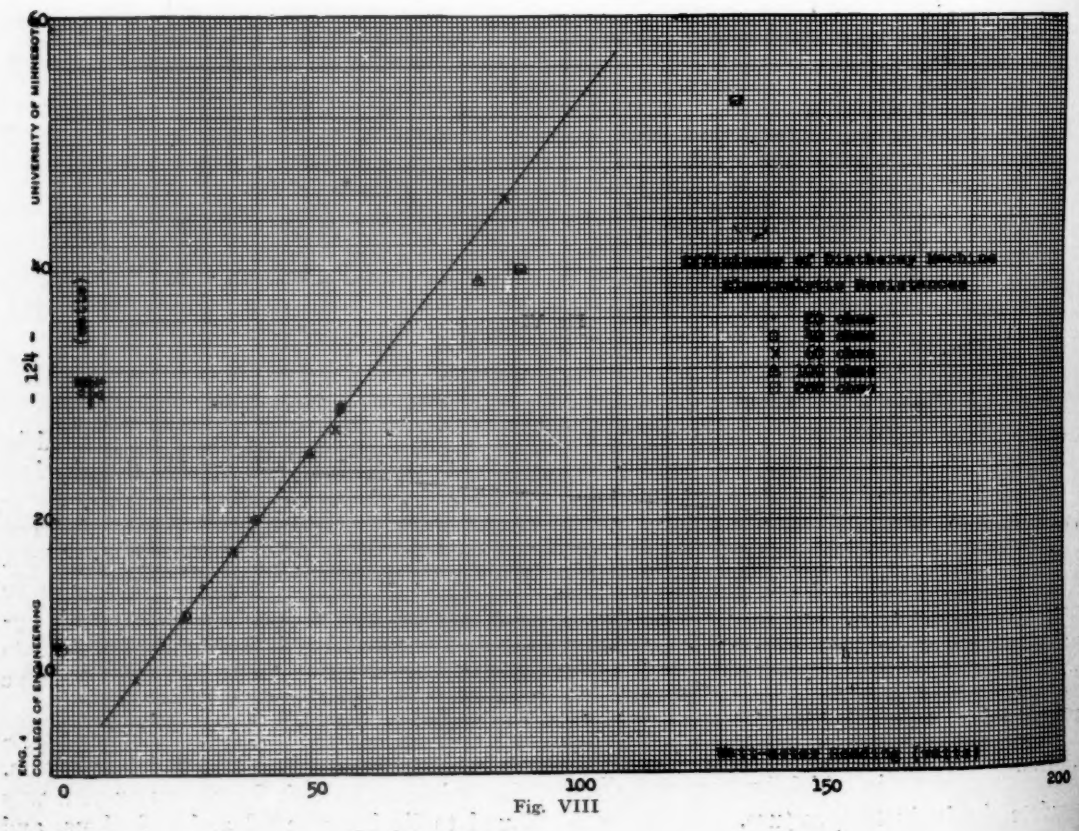


Fig. VIII

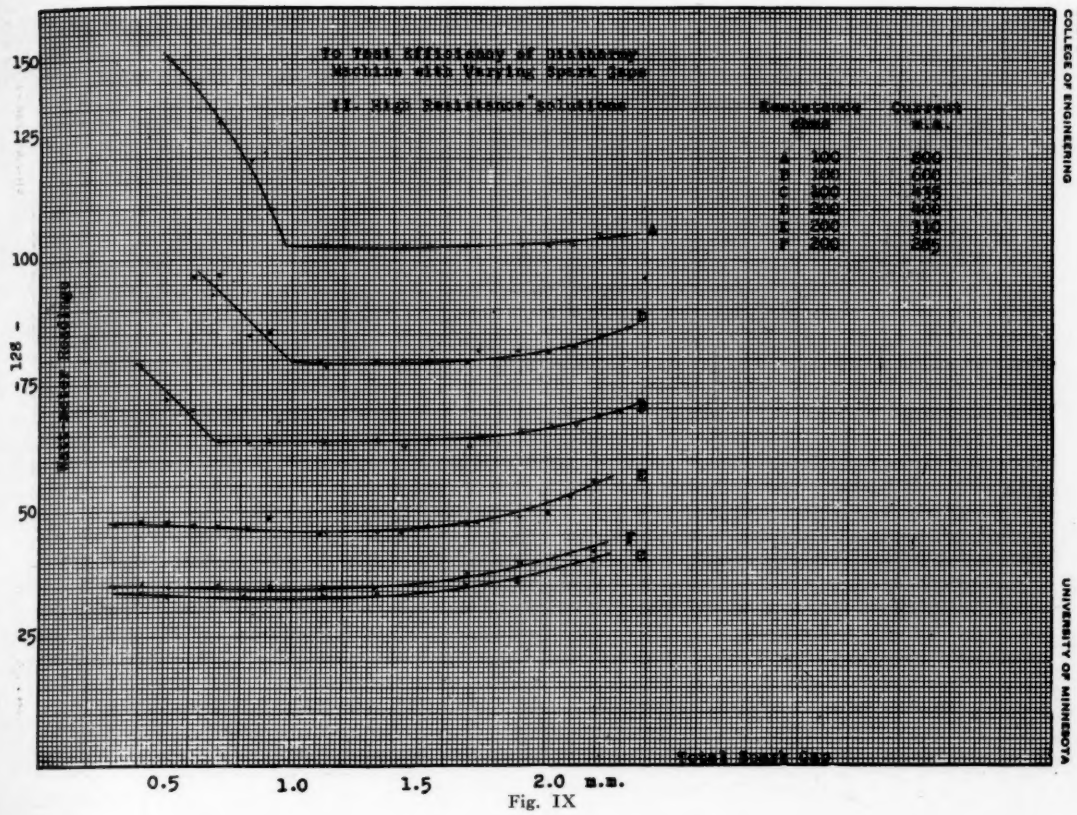


Fig. IX

did not change when lead foil electrodes were replaced by felt soaked in salt solution.

The heating effect of the high frequency current was tested on salt solutions placed in a calorimeter. The measurements show that with the amount of resistance usually present during treatments, the heating is proportional to the square of the current and to the resistance. The milliammeter therefore gives a fair indication of the heating current.

It has been shown that the frequency of the current is to a certain extent dependent upon the part of the circuit in which the patient is connected.

The efficiency of the machines depends to a certain extent upon the length of the spark gap. A certain range of the gap was found which gave a maximum efficiency.

Measurements of temperature of the skin under one electrode have been made and they show how it varies with time and with the pre-treatment temperature.

The general temperature was also measured during treatments of a number of patients. It was found to be either unchanged or increased to a very slight extent.

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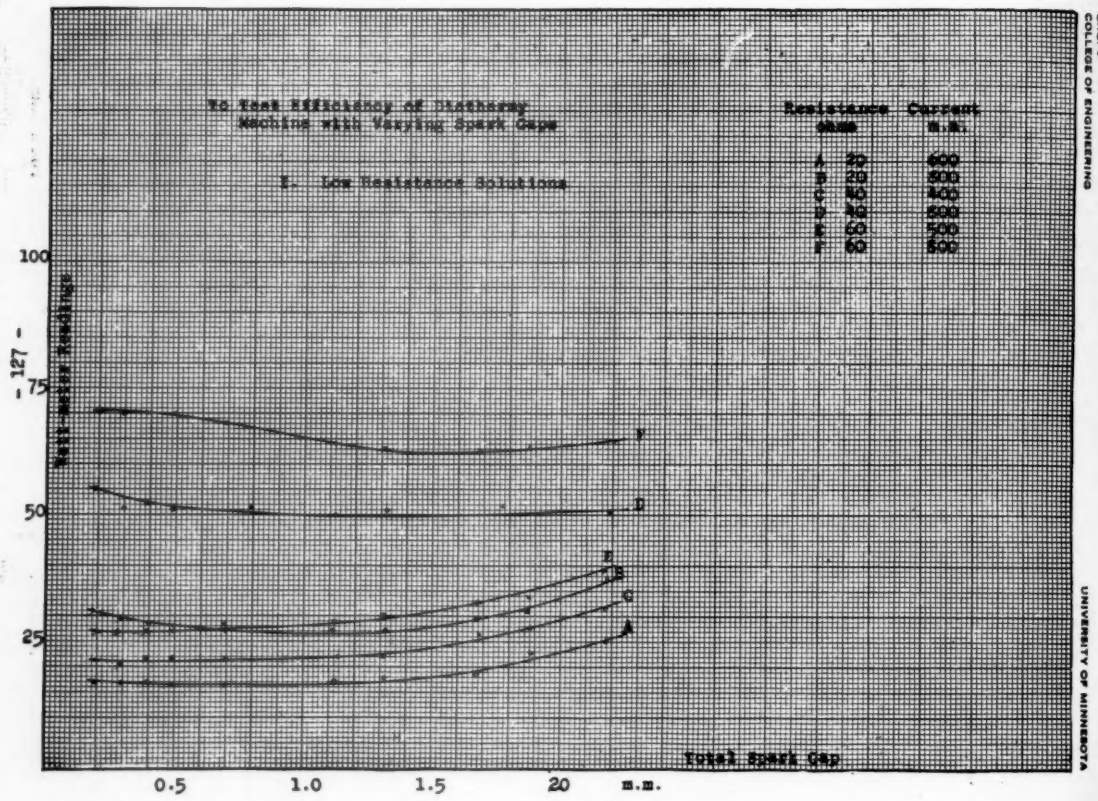
Discussion

DR. DISRAELI KOBAK: The average physician who is sincerely interested in physical therapy has had very little opportunity to master the physics of high frequency currents during his preparatory work in medicine. He therefore knows very little about the foundation upon which the structure of this therapy is built. He has received no medical nor pre-medical training by which to correlate the physical forces utilized by him in his practice. At best he has a grotesque conception of the physics of high fre-



quency currents, or of the nature of the dynamics of heat and light. The average physician makes use of diathermy in an empirical manner. He is satisfied most often to accept the reasons for its effectiveness on the authority of the printed word. Unfortunately, he lacks that critical judgment that comes with study and training and experience. It follows, therefore, that much of the accepted opinions on diathermy are in need of clarification or further substantiation. To be authoritative, this should emanate from qualified and experienced workers.

Stenstrom's studies on the nature of diathermy and its currents are timely but not altogether original. These studies are in line with those published in 1920 by Dowse and Iredell on the resistance of tissues to high frequency currents; they are related also to the investigations of Wildermuth who studied the resistances of individual tissues with high frequency currents. These studies are progressive links in the chain of evidence gathered together by d'Arsonval, Gildemeister, Einthoven, Nernst and others to prove that the lower level of high frequency currents are more stimulating than the higher frequencies as utilized in the average diathermy machines. It is unfortunate that the essayist did not make greater use of living material in his measurement of the levels of heat intensity. The substitution method of phantom tissues by means of certain concentrations of salts can never satisfactorily replace measurement with actual living material.

One can freely exceed the physiologic limits with dead tissues without, naturally, producing any untoward effect—an experience contrary to what may happen in living. This should be taken into consideration when we attempt to study the physical or biophysical nature of high frequency currents. The problem is frankly far from simple and requires refined laboratory equipment and above all a special orientation in electro-physiology.

I am inclined to lay stress on the value of the wattmeter, possibly more than upon the ammeter reading, when the instrument is properly connected with the circuit of the patient. I have observed that Professor Stenstrom connected the wattmeter with the primary circuit. I am wondering if he would not have obtained a different reading if he had connected the wattmeter with the secondary circuit. The wattmeter gives us an index to the equation that power is equal to $i^2 \times r$, and I think that this would be more demonstrable if the wattmeter were properly connected. Of course, a wattmeter is rather an expensive apparatus and the manufacturer, naturally, would be inclined to use the less expensive instrument, namely, the ammeter. The ammeter or the milliamper meter only gives us an index of the current introduced into the tissues, which is the index of heat. It does not, how-

ever, give us an index of the *amount* of heat created locally. There is no parallelism between one and the other.

I agree with the essayist that the general body temperature is raised very little with ordinary diathermy. It is usually sufficient for the purpose it is employed. If we remember vant Hoff's law that a 10° C. rise in temperature is usually sufficient to produce a double or treble increase in the physiological reaction of the tissue, we must conclude that it does not take very much temperature to set up a physiologic response. We can raise the general body temperature to a greater degree providing we insulate the patient so as to prevent heat irradiation. If we do that we can raise the general temperature to excessive heights; but this is not necessary, except in certain conditions where a hyperpyrexia is essential to the cure. In such cases, the temperature has been raised up to 107° F. or 108° F., and with beneficial effects.

DR. EWERHARDT: The subject under discussion is a purely technical one and concerns itself with a problem of diathermy of interest to all. One needs to study it carefully in order to obtain its full import. I am quite sure that most of you will want to read it as soon as it will appear in printed form. I have found several especially interesting points in Professor Stenstrom's paper which I shall be glad to mention at this time.

In speaking on the subject of frequency the author gives it as his opinion that there is no essential difference between the frequency of the region between 10,000 and 300,000, and of a current with a frequency of from 300,000 to 3,000,000. As we all know, this question of frequency has been a debatable one for some time; some telling us that a higher degree of heat production is possible only by virtue of a relatively high, others a relatively low, frequency. Others tell us that it is not primarily the oscillation frequency which determines the heat production but that the spark frequency is the important factor. Again, there are some who are of the opinion that heat production is but the end result of the application of a high frequency current through tissue. Again, we are told of the probability of a selective effect of the current upon cell tissue in accordance with the principles of natural protoplasmic vibration. Professor Stenstrom, as you have heard, dwells instructively on all of these factors. Concerning the latter he says: "So far no other effect has been detected than the heat production. The possibility of direct chemical effects cannot be denied, but they seem improbable, and there is no doubt that it is the heat that sets a limit for the current."

The author discusses the manner in which the high frequency current passes through human tissue, reminding us of past teachings to the effect that the skin has a very high electrical resistance as has also the underlying fat and soft tissue, and that once through the skin the current seeks the path of least resistance in the surrounding soft tissue. To some extent Professor Stenstrom agrees with this dictum, but hastens to tell us that this reasoning has to be modified considerably. He is of the opinion that the current is dependent not upon the resistance alone, but also upon capacity and inductance. He apparently does not believe, as has been postulated by others, that on account of the so-called skin effect, the current does not pass through the tissues but follows the surface, and that therefore the degree of deep seated heat is minor and the heating of the skin area major. He asserts that the skin effect is of importance to note for metallic conductors, but that it is negligible for electrolytes, and thus for tissue. He makes his point clearer by referring to the action of the direct current in its passage through human tissue. It, too, selects the path of least resistance. Both pass through the skin and underlying fat with this difference; the alternating current does not heat these structures to the same extent as the same amount of a direct current, due to the relatively large capacity effect of the epidermis. He states that it has not been determined at which frequency the heating of the epidermis becomes negligible, but that it seems evident the higher the frequency, the smaller the amount of heat produced in this layer, hastening to add that this phenomena becomes modified after passing an optimum degree of acceleration and that therefore further investigations are necessary to settle the question of frequency selectivity.

The author's investigation along the line of meter readings should be of particular significance to the technician. Experiments were made with and without patients in circuit, and with several types of high frequency apparatus. Some of his conclusions in this regard are: "The heat production in the different layers of tissues may be influenced by the frequency, and a certain number of milliamperes per square cm. of the skin may heat it more at one frequency than at another. Therefore it is possible that the skin might be heated more from one machine than from another, even though the same current is used." "It is also evident that the frequency of a certain machine only gives a very approximate value of the frequency used during treatment." Professor Stenstrom recognizes that many technicians disregard meter readings and rely almost wholly on subjective reactions of the patient. He properly sounds a warning note that such a procedure is not entirely safe and that it seems best to be at least partially guided by not allowing the meter reading to rise above a point generally regarded as safe. He suggests 20 M. A. per square cm. Others go as high as 50 M. A. per sq. cm.

The essayist concludes his exceedingly interesting and instructive paper with a few remarks on the question of measurements of the temperature of the skin and general body temperature rise. His observation of the latter is to the effect that during ordinary treatments the temperature in most of his 32 patients rose no higher than 0.1 degree C. while in some it was considerably less. This, I believe, is in general conformity with other observations.

DR. TITUS: It was very interesting to hear Professor Stenstrom speak about the dependability of the wattage, because it is my personal conviction that wattage is a factor.

Inasmuch as wattage does seem to be a factor, we can then say that the higher wattage will be

caused by a variation in voltage. I have always maintained from clinical experience that the higher the voltage of the machine the more efficient it seemed to be. I may be wrong in that and I should like Professor Stenstrom to correct me if he thinks that is true. But that is my interpretation. He has correlated the wattage with a given amperage and voltage, and I have analyzed it from the given amperage and frequency, with the thought of varying the voltage. He calls attention to the reduction in temperature of the skin under the electrode when the current has been on for some time. That is a physiologic action that always takes place in the presence of an active hyperemia. The extra heat convection is due to the vasodilatation of the subdermal circulation. When the current induces certain temperatures in the skin, we evoke higher temperatures underneath, and vasodilatation takes place. When the patients begin to perspire, the temperature of the skin drops.

It is also very interesting to learn that the higher frequencies tend to produce greater, subdermal heat than heat in the skin. That seems to suggest that deeper heat penetration is obtained with higher frequencies, and that such types of diathermy are more efficient for deep heating effects than those used by us today.

There is one point I want to bring to your attention which has not a great bearing on the topic under discussion, but has a physiological parallelism in connection with it. Sensation of heat of the human skin is purely relative. If you recall your laboratory experience in physiology, you will recollect that heat sensation of the skin is merely a matter of relativity. We cannot in reality feel heat. We feel the difference in temperatures. If you apply a dull needle to the back of your hand you will find certain areas that will give you a sensation of extreme cold and others a sensation of extreme heat. With a test tube of ice water you can elicit hot and cold sensation when it is brought in contact with the surface of the skin. Likewise, two fingers placed in separate tumblers of hot and cold water and then changed into a container of lukewarm water will provoke opposite sensations. The cold finger will feel hot and the hot finger will feel cold.

I call your attention to these classical examples because some people believe in skin tolerance doses of diathermy. I believe that is to be heartily condemned. Certain parts of the body are much more sensitive to heat and cold,—the lips, the eyelids, are particularly sensitive to heat and cold. One can, for example, obtain distorted sensations of heat in the skin as interpreted by the individual under treatment and be misguided in the dosage.

One should also remember that the deep parts of the body have no mechanism to detect the sensation of heat. There are no terminal fibers of hot and cold bodies underneath the skin. Therefore, we cannot feel heat beneath the surface of the skin.

For example, if we heat up the muscles, we feel warmth because the heat is brought by conductivity from the surface. It stimulates that part of the skin and evokes a sensation of warmth underneath. I failed to realize this until recently when I discussed the problem with the Professor of Physiology at Columbia. He indicated by several examples that it is impossible to feel heat beneath the skin. The patient who informs the physician of deep heat sensations is guided more by an active imagination than by facts. Indeed, this is a phenomena that cannot be accomplished even when desired.

I cannot entirely agree with Professor Stenstrom that all of the effects of diathermy are due to the heat created by the current. This is a conviction based on clinical observation and cannot be demonstrated. It does not seem logical that you can pass an oscillating current of high frequency through a part of a normal physiological machine and not distort the movement of ions in the flow of the electrical current. We cannot expect the current to oscillate 3,000,000 times a second or 1,000,000 times a second without in some manner affecting or influencing the ionic motion. There must be some effects on the living tissues we do not know of.

Dr. Kobak was with me in London when an interesting discussion took place between Cumberbatch and Turrell. We agreed with them that there are some actions due to oscillatory currents that have not as yet been demonstrated. Although the physicist can account for all the heat and energy produced, there are those who believe that much of the benefits derived from diathermy cannot be entirely accountable to heat alone.

DR. STENSTROM: I wish to thank you for the very interesting discussion. I don't think there is very much for me to say about these things. I might call attention to the fact that the studies I presented here were mainly measurements which I think will contribute to solve the problems relating to the use of the diathermy machine. Dr. Kobak said they were not new, but I don't know of any measurements of this type applied to the diathermy machine. Of course many measurements have been made with high frequency currents, but as I said, for instance, the resistance when you use electrodes such as those used in diathermy and applied in the way you are generally doing for diathermy,—I don't know of any such measurements and I don't know of any measurements that show the heat production in the way explained here.

I did not attempt to go into the biological effects at all. As long as we consider an electric current, I think that the passage of that current can only be dependent upon the physical qualities. There can be a direct or an indirect effect, but the passage of the current has to do with the physical qualities such as resistance, capacity and inductance.

It is true that if the wattmeter were put in secondary, the relation between the heat in the tissues and the amount of energy read on the wattmeter, would be closer, but there would still be a difference. There would, of course, be a loss of energy in the secondary of the circuit also, so one would have to calibrate it anyway.

It is true that the heat produced is proportional to the resistance, but if the resistance is kept constant, then the heat is proportional to the square of the current, for that reason the current will give a certain amount of information. There is rather little difference in the resistance of the skin of one person and of the skin of another. Hence, we will have about the same amount of heat produced.

As far as the effect of a *frequency* of 10,000 and 300,000 and 3,000,000 is concerned, I want to state that there is no definite limit between the frequency that stimulates the nerves and the frequency that does not. As we go up in *frequency* the stimulation becomes less and less, and for a higher frequency we have to use an intenser current in order to produce a stimulation; hence, if we use very intense current, the limit would have to be drawn higher than if we use less intense current.

As far as the skin effect is concerned, that is proportional to the conductivity of the material, and the conductivity of a metal is many times greater than the conductivity of electrolytes. You can see from that that the skin effects should be very much greater in metals. This is not a personal opinion; I take that from measurements made by others, which is found in the standard books in physics. We therefore can rely upon those statements.

As far as the voltage is concerned, I don't like to discuss that very much, but I want to say this: How do we measure it? It is very difficult to measure. Shall we measure the peak voltage or shall we measure effective voltage? Has the effective voltage ever been measured when the electrodes have been applied to the patient? I don't know of any such measurement.

As I said, it is possible that there are effects other than heat. It would be a splendid contribution if we could obtain definite proof of other effects than that of heat. Until we get the proofs I don't see that we have anything to build on at all. What I have been trying to do is to record the few facts we have observed and to build up logical conclusions therefrom.

THE DEVELOPMENT AND EFFECT OF DEEP-SEATED HEAT IN THE FEMALE PELVIS

A NEW DIATHERMY TECHNIC. PRELIMINARY REPORT *

G. D. ROYSTON, M.D.; F. H. EWERHARDT, M.D.; M. A. ROBLEE, M. D.; AND F. B. ZENER, M.D.

The use of heat in the treatment of certain pathological conditions has been empolyed for centuries. Local applications for this purpose penetrate to a very slight depth below the surface because the tissues are poor conductors and the (capillary) circulation of blood beneath the epithelium conveys the heat away from the parts through which it circulates.

According to the degree of heat produced, we distinguish between medical diathermy (below 114° F.) and surgical diathermy or electrocoagulation above the 114° F. limit; Cumberbatch observed the latter temperature to mark the beginning of cell necrosis and continuing to actual tissue destruction, producing thermocoagulation and slough.

The frequency of chronic inflammatory conditions in the female pelvis and the unsatisfactory results obtained following radical surgical procedures, should make this an ideal field for treatment with deep-seated heat.

The direct destruction of bacteria within living tissue by heat alone seems of doubtful value. Medical diathermy should be of value because of the production of hyperemia of the tissues, phagocytosis, and the general reaction of the body tissues to heat rather than the thermodestruction of bacteria.

In 1926, Cherry, from the gynecological service of the Harlem Hospital, enthusiastically reported the production within the tissues of higher temperature readings than other observers have been able to secure. He used the Corbus electrode and the Chapman electrode.

Although many enthusiastic investigators report producing within the affected tissues temperatures of 102° to 122°, Bettman and Crohn, from their work, reached the conclusion that it seemed impossible to focus the site of heat in any given internal viscus. They could not demonstrate experimentally actual localized deep tissue heating and their conclusions were that the greatest amount of heat occurred at the electrodes and that the deeper portions received a proportionately smaller amount of current, hence less heat.

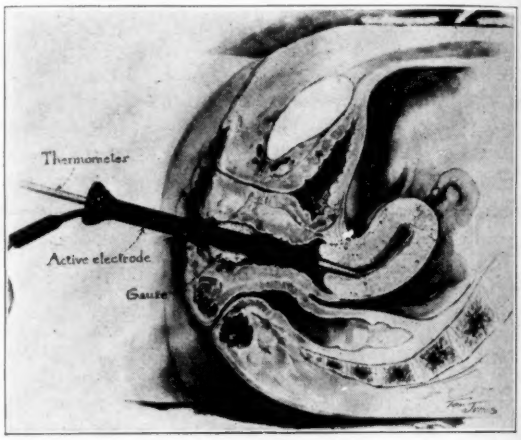


Fig. 1. Corbus electrode.

Scheffey and Schmidt, from the departments of gynecology and physical therapy in Jefferson Medical College, Philadelphia, reported critically on diathermy in pelvic disease and apparently they show that diathermy gave results approximately as good as those obtained by surgery without the danger or discomfort incidental to surgical intervention. They used the abdominosacral and abdominovaginal electrode methods, as well as surgical dessication to the cervix when the cervix was infected. Treatments were given three times a week, with a duration of fifteen to thirty minutes each. No temperature readings were given when the abdominosacral electrodes were used. In their abdominovaginal methods a vaginal electrode was inserted in the vaginal vault behind the cervix. The temperature of the vaginal electrode measured by a thermometer recorded 100½° to 102° F. They concluded: "That whatever diathermy accom-

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From the Departments of Obstetrics and Gynecology and Physical Therapeutics, Washington University School of Medicine.

(By courtesy of The Journal of the Missouri State Medical Society.)

plishes is due to the increase in circulation brought about by a local application of heat rather than from any heat generated in the diseased tissues themselves, and surely not from any destruction of bacteria by heat."

When pelvic diathermy investigations were started here in June, 1929, in the department of physical therapeutics, it was felt that a temperature of 110° F. throughout the pelvic organs would be of greater value than higher localized temperatures. We also felt that the only way to record temperature readings was by thermometers placed in the *treated tissue* itself and in no way incorporated in any part of the electrode. Special thermometers that would record changing temperatures were placed in the cervical canal, in the rectum and in the urethra to give simultaneous readings. The rectal thermometer was placed well up against the rectovaginal septum at a distance above and posterior to the cervix.

In our work it seemed that the machines giving the best results were of the general specifications as follows:

A relatively low voltage, as estimated by the manufacturer to be 2000 to 2500 (not to exceed 3000), and a frequency of 800,000 to 1,250,000.

The amperage varies with the machine used and is not constant because of the influence of other factors, such as voltage, frequency, tissue resistance, spark-gap, etc.

Our experience with a high voltage machine over 2500 was not satisfactory because it gave faradic sensations, sparking locally and generally. At times with the Chapman electrode the patients complained of vaginal discomfort.

We had first tried abdominosacral electrodes of sufficient surface area posteriorly to cover the entire lumbosacral curve, while the anterior electrode covered the entire abdomen and was so shaped that it did not come in contact with the iliac crests. No local rise in temperature in either rectum or cervix was observed. When the current was increased to the maximum point of tolerance a general systemic rise of one-half to one degree Fahrenheit was noted.

We then used a vaginal electrode which was a large bivalve Graves' speculum, which was placed in the vagina in an upside-down position so that the handle of the speculum

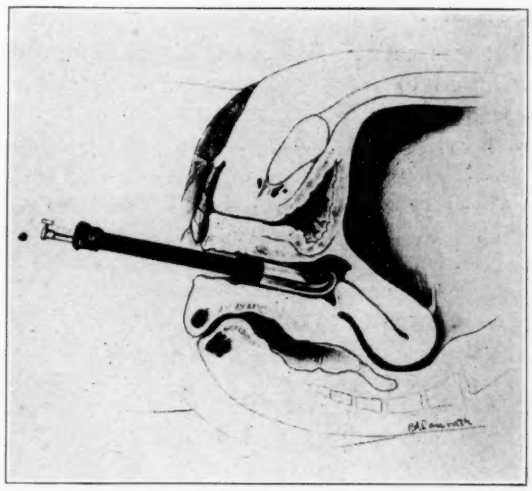

Fig. 2. Chapman electrode.

pointed anteriorly towards the symphysis. This handle was used as a binding post for the electric terminal. We call this the Roblee Electrode No. 1. Rectal temperatures with the lumbosacral plate and vaginal electrode average 108° to 109° F., using a current of 1800 to 2200 milliamperes. Corresponding cervical temperatures were 102½° to 103° F. When an anterior abdominal electrode was used instead of the posterior lumbosacral type with the vaginal electrode, the rectal temperatures were from three to four degrees lower; thus we felt that the anterior ab-

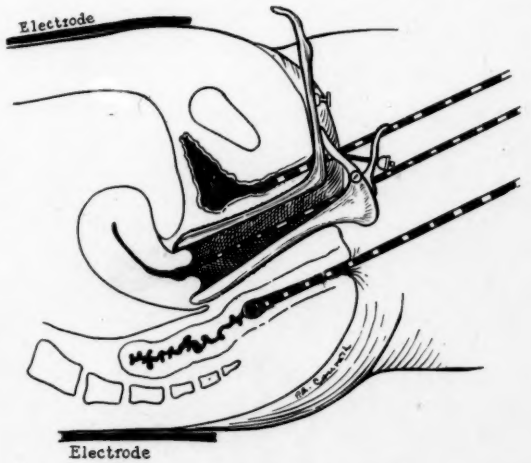

Fig. 3. Roblee electrode No. 1.

dominal electrode with the vaginal electrode seemed to concentrate the heat in the anterior portion of the pelvis, just as the heat seemed to be concentrated posteriorly when the lum-

bosacral electrode was used with the vaginal electrode.

It was noticed that five to six minutes were required to reach the maximum milliamperage, 1800 to 2200, using the above technic so that the patient would not complain of "hot spots." This milliamperage could be tolerated for ten to fifteen minutes. It was then noticed that the thermometer readings fell off from two to three degrees in the rectum and from one to two degrees in the cervix. The patient complained of feeling warm "all over" and usually broke out in profuse perspiration. There was a slight increase in pulse rate at this time and in some instances the oral temperature went up a half to one degree Fahrenheit. It was a purpose of this study to demonstrate just what heat could be obtained in the pelvic tissues and no attempt was made at first to treat any pathological condition. The types of cases studied were clinic cases with no gross pelvic pathology, such as tumors or subacute adnexal infections. The next step was to treat at weekly intervals, except when menstruating, a series of some ten patients who had chronic salpingo-oophoritis with a moderate amount of chronic pelvic cellulitis. Observations on these ten cases showed results similar to those obtained by Scheffey and Schmidt, that is, pelvic tenderness was decreased and the mobility of the uterus markedly increased. The ten patients thought that the treatments improved their clinical symptoms, such as dysmenorrhea and general pelvic tenderness.

Before proceeding further with the treatment of a large number of cases, we wished to improve the technic. The next step was to make a four-blade vaginal electrode which could be placed in the vagina as a hollow cylinder made of overlapping blades and then dilated in order to bring the blades with forceful contact against the anteroposterior and lateral walls of the vagina, the posterior blade being the longest of the four and pressing well back into the culdesac. This vaginal electrode, which we call the Roblee Electrode No. 2, when used with the lumbosacral or the belt electrode, gave consistently rectal and urethral temperatures of 109° to 110° F.; however, the cervical temperatures were usually 103° to 104° F. We felt that this four-blade expanding vaginal electrode was useful in heating the adnexa, culdesac, vaginal wall, and especially the Bartholin and Skene's glands. At this stage of our work, Zener, who had previous diathermy experience elsewhere in the use of the Corbus and Chapman electrodes, assisted us. Zener felt that if a cylindrical vaginal electrode were made with four short blades that could be opened and then closed around the cervix, more heat could be concentrated in the cervical canal and immediate parametrium without material loss in rectal and urethral temperature readings. Such an electrode, which we designate as the Zener Cervicovaginal Electrode No. 1, gave us practically uniform thermometer readings in the cervical canal, urethra and rectum. These temperatures were uniformly 109° to 110° F. in the cervix and urethra, and 108° to 109° in the rectum. We then felt that we

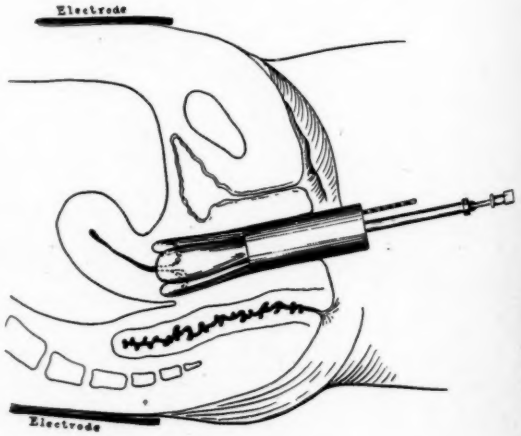

Fig. 4. Zener electrode.

had sufficiently developed and standardized our technic to start treating a series of cases with well developed adnexal disease, including subacute salpingo-oophoritis and subacute pelvic cellulitis. These cases were treated two to three times a week and were instructed not to take hot douches at home. Douching with plain water at body temperature, as required for excessive discharge, was permitted. These patients had blood smears for differential Schilling counts and white blood cell counts as a check on the degree of activity of the pelvic infection. Oral temperatures were taken as well as continuous temperature readings in the urethra, cervix and rectum. Treatments were given over a period of thirty minutes, the belt electrode being used with the cylindrical Zener cervicovaginal

electrode. After eighteen to twenty-two minutes the local temperatures in the urethra, cervix and rectum would fall from 110° to about 106° to 108° F. At this time the oral temperature would become slightly elevated from one-half to one degree. The patient would complain of being warm all over and in some instances would perspire very freely. We explained the local drop in temperature as being due to an intense local hyperemia, a greater blood supply to the pelvic organs dispersing rapidly the local heat produced.

One patient who had a supravaginal hysterectomy performed elsewhere about two years ago was used in our observations. This patient had remaining a large cervical stump the canal of which would readily admit our cervical thermometer. We found that when the dilating vaginal electrode was used the temperature in the cervical stump was about one to two degrees lower than the average. When we used the Zener cervicovaginal electrode the temperature went up one to two degrees higher than the average case and there was no tendency for this temperature to fall as in the other cases. This experiment, we felt, checked our ideas on the hyperemia in the pelvis. Since this patient had no uterus the blood supply was necessarily materially lessened and the amount of hyperemia would be correspondingly less. One other point that was noticed which might be mentioned here was that when the expanding vaginal electrode was used, whatever cervical temperatures were obtained (103° to 104°) did not have the tendency to fall as the urethral and rectal temperatures did. This would indicate that the lower cervical temperatures created in this manner might be an actual temperature of hyperemia.

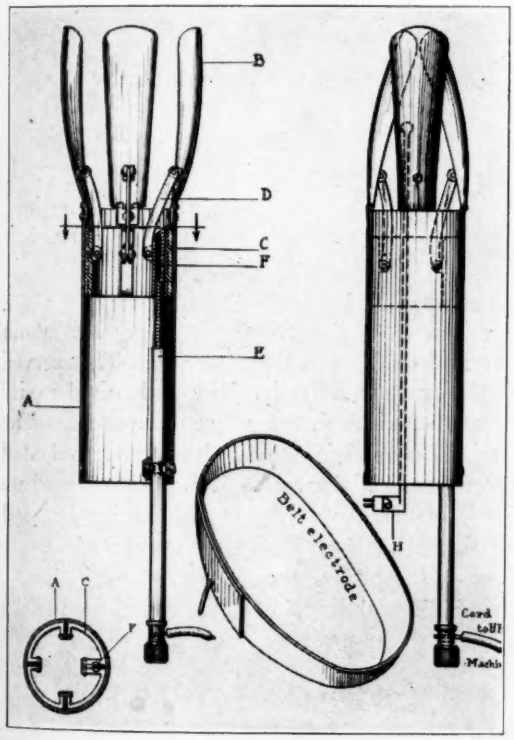

Fig. 5. Descriptions of the Zener cervicovaginal electrode. (A) Brass tube 1¾ inches in diameter by 4 inches in length, to which are attached by hinges four blades (B) 2 inches in length. These blades are made to expand and contract by means of movement of connecting rods (D) attached to a collar (C) which fits inside the tube (A). The movement of the collar (C) is obtained by means of a rod (E) which is threaded into one shoulder (F) of the collar (C) and extends one inch beyond the end of the tube. The blades open to a diameter of two inches. For purposes of better visualization of the cervix the instrument is fitted with an endoscopic light. The inset at left shows the details of collar (C).

When the patient is in the lithotomy position the electrode may be inserted through a bivalve speculum. The blades of the electrode are closed during the insertion and then opened. This places the cervix between the blades of the electrode. A thermometer is inserted into the cervical canal and the blades of the electrode are closed about the cervix. The patient is allowed to lie flat while the treatment is being given. Additional thermometers are placed in the bladder and rectum.

		W.B.C.	Myle.	Jun.	Stab.	Seg.	Bas.	Eos.	Lym.	Mono.
M. B.	(1)	9850	0	0	6	71	0	1	17	5
4-1-30	(2)	7200	0	0	9	54	0	3	24	10
4-21-30	(1)	8150	0	0	6	69	0	2	20	5
	(2)	6750	0	0	7	69	0	1	18	5
4-24-30	(1)	10600	0	0	5	74	0	1	16	4
	(2)	9900	0	0	2	60	0	2	35	1
4-28-30	(1)	10500	0	0	3	65	0	1	29	2
	(2)	9150	0	0	2	67	1	1	28	1
F. H.	(1)	10950	0	1	8	55	1	7	24	4
4-20-30	(2)	9250	0	0	4	55	0	4	33	4
4-24-30	(1)	8850	0	0	3	56	1	4	32	4
	(2)	6250	0	0	3	33	0	6	56	2
4-28-30	(1)	8800	0	0	3	56	0	4	32	5
	(2)	6400	0	0	4	40	0	6	47	3
H. E.	(1)	11750	0	0	9	53	1	0	36	1
4-17-30	(2)	14400	0	0	9	60	0	0	28	3
4-21-30	(1)	14650	0	1	6	43	0	2	45	3
	(2)	8850	0	0	8	55	0	0	36	1
4-24-30	(1)	13800	0	0	5	65	0	0	27	3
	(2)	14580	0	0	5	67	0	0	26	2
4-28-30	(1)	11700	0	0	5	70	0	1	23	1
	(2)	11000	0	0	4	53	1	1	38	4
5-1-30	(1)	10850	0	0	5	80	0	0	41	4
	(2)	9850	0	0	6	53	1	2	35	3
L. V.	(1)	9750	0	0	2	67	0	2	23	6
4-17-30	(2)	7900	Not good.							
4-21-30	(1)	8350	0	2	7	50	1	1	35	4
	(2)	8650	0	0	7	68	0	1	20	4
4-24-30	(1)	7700	0	0	5	54	0	2	35	4
	(2)	6950	0	0	4	47	0	2	44	3
4-28-30	(1)	9250	0	0	4	60	0	1	33	2
	(2)	7800	0	0	4	48	1	3	41	3
A. C.	(1)	9200	0	0	6	67	0	0	25	2
4-22-30	(2)	7560	0	0	5	69	0	1	23	2
4-29-30	(1)	8900	0	0	7	59	0	1	48	5
	(2)	8100	0	0	4	47	0	1	47	8

Fig. 6. Interpretation of the differential counts. Case M. B. Slight infectious blood picture at the start that became noninfectious. Case F. H. Same. Case H. E. Same. Case L. V. Noninfectious blood picture at the start, then slightly infectious, then ended negative. Case A. C. Slightly infectious picture.

		W.B.C.	Mylo.	Jun.	Stab.	Seg.	Bas.	Eos.	Lym.	Mono.
L. M.	(1)	9000	0	0	6	64	2	0	24	4
4-18-30	(2)	7750	0	1	5	57	0	1	35	1
4-21-30	(1)	7450	0	0	4	59	1	0	28	8
	(2)	----	0	0	6	60	1	0	25	8
4-22-30	(1)	8900	0	0	3	64	0	0	20	4
	(2)	6100	0	0	7	59	1	0	27	6
4-28-30	(1)	9600	0	0	6	67	0	0	22	5
	(2)	8650	0	0	9	56	0	0	28	7
R. H.	(1)	11,550	0	0	4	63	1	3	28	1
4-17-30	(2)	11,600	0	0	4	68	1	0	19	8
4-20-30	(1)	10,800								
	(2)	12,500	0	0	7	53	0	2	31	7
4-22-30	(1)	9900	0	0	3	64	0	0	20	4
	(2)	6100	0	0	7	59	1	0	27	6
4-29-30	(1)	10,500	0	0	10	63	0	0	22	5
	(2)	10,360	0	0	6	47	0	0	36	10
K.	(1)	12,450	0	0	5	61	0	1	31	2
5-1-30	(2)	11,000	0	0	2	56	0	0	36	6
Dej.	(1)	9850	0	0	13	62	0	0	21	3
4-22-30	(2)	10,000	0	0	10	60	0	0	23	7
4-25-30	(1)	9350	0	0	10	59	1	0	29	3
	(2)	8150	0	0	10	54	1	0	29	6
4-29-30	(1)	9500	0	0	4	76	0	1	14	6
	(2)	10,450	0	0	6	68	0	1	20	5
O.	(1)	10,050	0	0	5	65	1	0	24	5
4-22-30	(2)	9250	0	0	6	64	0	0	24	6
4-25-30	(1)	9600	0	0	5	69	1	1	20	5
	(2)	9650								
E.H.	(1)	11,450	0	0	4	45	1	3	46	1
4-18-30	(2)	9000	0	0	4	42	0	3	45	6
4-18-30	(1)	10,300	0	0	4	68	1	1	27	7
	(2)	8650								
A.W.	(1)	12,950	0	1	8	58	2	1	28	2
4-17-30	(2)	15,450	0	1	6	65	0	5	21	2
4-18-30	(1)	9200	0	0	7	61	0	1	27	4
	(2)	8500	0	0	4	66	0	0	25	5
4-29-30	(1)	8700	0	0	6	59	2	0	25	8
	(2)	8400	0	0	9	56	0	3	29	3

Fig. 7. Interpretation of the differential counts. Case L. M. Slight infectious picture, became negative, then slightly positive, then negative, ended positive. Case R. H. Start noninfectious, became infectious, then negative, then very slightly positive. Case K. Negative blood picture. Case Dej. Two positives ending with an almost negative. Case O. Very slightly positive. Case E. H. Negative blood picture. Case A. W. Slightly positive blood picture throughout.

We feel that the temperature readings associated with the electrodes of the Corbus or Chapman types are due to the proximity of the thermometer to the internal (vaginal in our cases) electrode and do not represent the true degrees of heat penetration in the tissues a few centimeters distant. With these types of electrodes we were unable to reproduce in the *same* patients a degree of tissue heat one to three centimeters distant from the electrode above 104° to 106° F. and of shorter duration; most temperature readings were less (102° to 103° F.), while with the Zener electrode we had no difficulty in producing regularly uniform temperatures of 110° F. in the bladder, cervix and rectum of longer duration. Only when the Chapman vaginal electrode was so placed as to be in close proximity to the thermometer in the bladder or rectum were we able to obtain higher temperatures.

Experiment in Obtaining the Temperature in the Uterus With a Thermometer Bulb Against the Fundus

Uterine canal measured by sound and the thermometer placed to the same depth against the fundus. Zener cervicovaginal electrode used in routine manner. Fundic temperature 103°. The thermometer was then pulled out into the cervical canal. Canal reading 107°. Thermometer pushed into fundus fell to 103°. This, we feel, is a very accurate experiment and shows that the temperature is rapidly carried away by the blood stream from the electrode contact, and what temperature is reached may be due to hyperemia and some direct extension.

Experiment on a Living Dog to Show the Effect of the Circulation in the Dispersing of the Local Heat Generated in the Pelvis

A female dog was anesthetized with ether. A three-inch belt electrode was placed about the dog's thorax, the hair being shaved in this area. A solid vaginal electrode of the Morse type was used. This is olive-shaped, about one and three-fourths inches long and about one and one-fourth inches wide. This served as the active electrode. The abdominal cavity was opened and the uterus exposed. The vaginal electrode could be easily palpated through the abdomen and was pushed well up into the upper portion of the vagina in good contact with the bicorunate uterus. The site was chosen about one and one-half inches to two inches above the electrode. The uterine wall here was opened and the thermometer bulb passed into the muscular wall. A loose ligature of silk was used to steady the thermometer bulb in place. This ligature was not passed tight enough to constrict in any way the blood supply of this area.

Another thermometer was placed in the adnexal region out to the lateral portion of the pelvic wall, not in any way coming in contact with the vaginal electrode. Another thermometer was placed under the rectus muscle in contact with the pelvic peritoneum at a point proximately above the thermometer that was in the pelvic adnexal region. Another thermometer was placed in the vagina next to the vaginal electrode.

		W.B.C.	Myle.	Jun.	Stab.	Seg.	Bas.	Eos.	Lym.	Mono.
D. 5-1-30	(1)	9150	0	1	7	53	0	1	31	7
	(2)	8200	0	0	5	50	0	4	35	6
F. 4-29-30	(1)	12,650	0	0	4	70	0	1	21	4
	(2)	11,650	0	0	6	50	0	1	39	5

Cervical Differential Counts before and after

		W.B.C.	Myle.	Jun.	Stab.	Seg.	Bas.	Eos.	Lym.	Mono.
K.	(1)	9850	0	0	6	55	0	0	37	2
	(2)	11,900	0	0	8	58	0	0	32	2
5-1-30 Finger Differential Counts before and after										
	(1)	12,450	0	0	5	61	0	1	31	2
	(2)	11,000	0	0	2	56	0	0	36	6

Cervical Differential Counts before and after

D.	(1)	8700	0	0	5	47	0	1	43	4
	(2)	21,000	0	0	7	46	0	2	42	3
5-1-30 Finger Differential Counts before and after										
	(1)	9150	0	1	7	53	0	1	31	7
	(2)	8200	0	0	5	50	0	4	35	6

Cervical Differential Counts before and after

EH.	(1)	10,450	0	0	4	45	2	2	47	2
	(2)	13,500	0	0	4	50	1	2	41	2
5-1-30 Finger Differential Counts before and after										
	(1)	10,250	0	0	5	50	0	0	41	4
	(2)	9850	0	0	6	53	1	2	35	3

Cervical Differential Counts before and after

AC.	(1)	7450	0	0	5	44	0	0	48	3
	(2)	9400	0	0	6	61	0	0	28	5
4-29-30 Finger Differential Counts before and after										
	(1)	8800	0	0	7	39	0	1	48	5
	(2)	8100	0	0	4	47	0	1	47	8

Fig. 8. Interpretation of the different counts. Case D. Slightly positive. Case F. Negative.

The current was then turned on, spark gaps opened wide, milliamperage reading about 2000, temperature rose rapidly within three to four minutes. The assistant held the uterine thermometer so that the bulb of this thermometer was at least one and one-half inches to two inches above the cervical electrode. The following table will show the simultaneous readings obtained.

TABLE I

Time	Vaginal Temperature	Uterine Temperature	Adnexal Temperature	Peritoneum Abdominal Wall Temperature
3:45 to 3:50	111	111	111	108
3:52	111½	112	112	109
3:53	112	112	112½	110
4:00	113	114½	114	112
4:01	113	115	115	112½
4:03	113	114	114½	112
	(Vaginal temperature the same, slight fall on the three other thermometers after two minutes time. We believe this to be due to hyperemia although this temperature is the lethal point of cell tolerance.)			
dog died				
4:04	113	116	116	114
4:06	115	118	116	117
4:10	117	122	117	117
4:15	117	124	119	118½
4:17	117	126	118	120
4:18	118½	130	119	120
4:20	119	135	122	120
4:22	122	140	122½	120

Note. Milliamperage and all machine adjustments were constant throughout the entire experiment. At 4:22 an incision was made in the thoracic wall under the passive electrode belt and the temperature reading of 119° was obtained. At the same time an oral temperature was taken of 108°.

A Possible Interpretation of the Experiment

1. It seemed that our electrode surface area was larger in proportion to the dog's size than our present technic of electrode surface area as compared with a human adult.

2. The entire pelvis seemed to be heating uniformly without difficulty.

3. The adnexal regions and the uterine wall temperatures remained approximately the same until the dog died, while the abdominal wall area was from two and one-half to three degrees lower.

4. This would seem to indicate a tendency to heat the deeper structures more completely. In other words, the heat seems to radiate through the tissues rather than follow the muscle-fascia-skin route.

5. We believe the fallen temperatures were due to a hyperemia which was not able to carry away the local heat sufficiently to prevent blood coagulation thrombosis and tissue destruction. This, we think, caused the death of the dog.

6. It was noted that the temperature rose immediately as soon as the dog died. That is, as soon as the circulating blood stopped in this removal of local heat.

7. Note that the uterine temperature was higher than the vaginal or adnexal or abdominal wall at the end of the experiment. Also note that the vaginal, adnexal and abdominal wall temperatures were the same at the end of the experiment and that the temperature under the passive electrode belt was approximately the same.

8. This might indicate that there is a tendency to heat all tissues between active and passive electrodes uniformly except those tissues that are so deep that there is no chance for the heat to escape by convection and radiation such as would be the case in the uterus.

Possible Suggestions in Improvement of Our Present Technic as Suggested From This Dog Experiment

1. Increase our electrode surface area. This would seem to make for more uniform heating without the local high temperatures which are not desirable.

2. Decrease the space between our active and passive electrodes. This to be done perhaps by a passive electrode which could be so arranged as to press in the abdominal wall

in the subumbilical region. This would limit our area heated and we think we could hold a more uniform temperature by doing this.

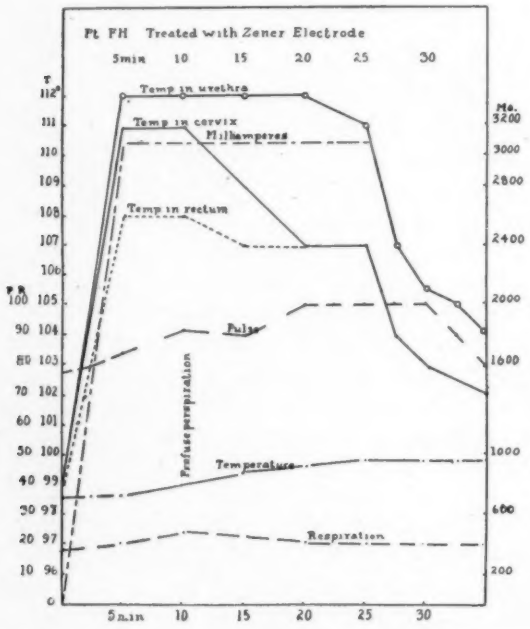

Fig. 9. Graphic representation of simultaneous temperature readings in the urethra, cervix, rectum and mouth. Also, pulse rate and respiration. Milliamperes also recorded, as well as the time intervals during a treatment of thirty minutes. Note temperature of cervix falls markedly between ten and twenty minutes of treatment, while oral temperature rises synchronously. This shows we believe that the heat generated locally in the pelvis is dispersed generally throughout the body by the marked hyperemia and the increased blood flow through the pelvis.

Experiment Noted at Operation

On a patient who had eight weeks of diathermy treatment, using a Graves' bivalve speculum as a vaginal electrode and a large lumbosacral plate as a passive electrode.

Young woman, 22 years old, history of gonorrhea three years before. Pelvic findings: bilateral tubo-ovarian masses the size of lemons; uterus second degree retrodisplaced, fixed; pelvis was very tender and indurated. History of chronic appendicitis and bilateral Bartholin abscesses. Operation for appendix. Ovaries normal size, tubes injected, open, pulled down into the culdesac by thin cobweb adhesions. These thin adhesions quickly broke up on touch and separated much more easily than the usual dense, nonseparating type of chronic pelvic inflammatory adhesions. Patient now in excellent condition, no menstrual disturbance and no pelvic pain.

Experiment Using Different Electrodes in Beef

The relative size of the meat area in these experiments carried out on tissue which contained no active blood supply limits the actual comparison of the larger electrode with the small Corbus type electrode. Much more heat was produced in a shorter period of time with the larger electrodes throughout the beef. In order to heat the beef to the periphery with the Corbus electrode, it was necessary to char the meat immediately around the electrode.

Electrode temperatures of 160° to 180° were obtained, while temperatures in the beef one or two centimeters distant were from 15° to 20° lower. With larger electrodes more uniform temperatures throughout the beef were reached without the local charring effect, although high electrode temperatures were more easily reached. The meat cooked thoroughly as shown by cross-section and there was a decided tendency to spread in a V-shaped area of decreasing temperatures as the periphery was approached. The V-shaped areas of cooking were much more marked wherever the passive electrode came in closer apposition to the meat.

Conclusions

1. Definite evidence that no case was made worse during treatment; that is, no chronic process became acute, as shown by Schilling hemogram.

2. All variations were so slight that no other conclusions could be drawn from this limited series.

3. Slight cold in patients could be responsible for such changes noted.

4. The fluctuation in lymhocytes occurred in many cases and cannot be used to indicate anything in particular, not even the degree of hyperemia.

5. The increase in polymorphonuclears is also subject to marked variation and must not have any specific interpretation.

6. The constant increase in the cervical white count is indicative, of course, of hyperemia.

7. The Zener cervicovaginal electrode and technic as described will result in temperatures in the cervical canal averaging 111° F., urethra 108°, rectum 108°, with extreme high

temperatures of 115°, 112°, and 110° respectively.

8. It is impossible to maintain this degree of heat for a period of over five to eight minutes, due to the dissipation of heat by the blood stream.

9. There was found universally a rise in temperature by mouth, increase in pulse and respiration.

10. Symptomatically, all patients were improved. If temperatures above 113° (cervical temperature) are used, the patient invariably complains of feeling worse, increase in pelvic pain following treatment and increase in tenderness, etc.

The work with this new Zener electrode is too recent as yet for us to report any clinical results. Of our fifteen cooperating patients who have received four or more treatments, increased mobility of the uterus has been definitely determined in all. At present we are treating a constantly increasing number of patients with chronic inflammatory processes and at a later date we shall report the results we obtained from the application of deep-seated heat to the female pelvic tissues by means of this new technic.

N. B. We wish to thank Miss Cotton and Mr. Byland for their part in the blood work, differentials, total white counts and routine work. We are indebted to Dr. Bredeck for assistance in the interpretation of the Schilling differentials.

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FURTHER STUDIES IN THE PROBLEMS OF OBESITY *

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In spite of a widespread interest by the laity in obesity, the contemporaneous literature betrays a regrettable indifference by general practitioners to its problems. As a result, countless patients fail to obtain relief at the hands of their medical advisers and, either resort to self-dieting and self-medication or, worse yet, fall prey to charlatans, faddists, beauty culturists and like gentry.

It is of some importance that we be agreed on a definition of obesity. Many have been proposed. This shows that either the affection is so complicated that it defies a brief definition, or else, that none has proved generally acceptable. As a matter of fact the problems of obesity are not so complicated that the earnest student can not grasp them by a little application; nor is there any reason why a generally acceptable definition should be unattainable.

As a working hypothesis it may be accepted that:

Obesity is a distinct pathologic entity clinically manifest by various subjective symptoms and by abnormal deposits of fat either in parts of or throughout the body.

In other words, the objectively demonstrable corpulence due to the accumulation of abnormal fat is merely a symptom of a definite disorder.

Etiology

Of greater importance is the etiology. Here, too, one encounters conceptions, which have not enjoyed general approval. It has been customary to classify obesity according to certain assumed causes. Generally three main groups were recognized, namely, exogenous, endogenous and constitutional types. For purpose of discussion it may be permitted to classify obesity as follows:

1. Exogenous, or alimentary,
2. Endogenous, or metabolic,
3. Idiopathic, or constitutional, and
4. Trophic obesity.

Exogenous Type

The first group—the exogenous—can be disposed of in a few sentences. It has been the custom to accept for this category all patients who presented no other demonstrable cause or "diatheses," but who appear to pay the penalty for gradually amassing a greater intake of calories than was necessary for their expenditure of muscular energy. The German writers gave this form of alimentary obesity the name: "Mastfettsucht," the first part of the compound word being taken from that used to describe overfeeding of animals.

Radical as it may appear, one is, nevertheless, constrained to deny this classification any scientific justification, for a number of reasons.

No positive proof has as yet been brought forward that increased intake of food and lessened expenditure of muscular energy in themselves are sufficient to produce obesity. If overfeeding were the sole cause, then obesity should indeed be more prevalent than it is today, for at least in the United States the well-to-do consume far too much food at banquets, in restaurants and in their homes. When one considers that in groups of men and women living under like conditions (armies, navies, educational institutions, penal institutions and the like) a certain percentage become obese, while the majority remain normal, and when one further observes that many men and women eat even more than is consumed by fat people without becoming corpulent, it is difficult indeed to accept the exogenous theory.

Here enters the question: What becomes of the physiologic functions of the body which play a decided role in controlling alimentary regulation? Is it not reasonable to assume that, though with our present diagnostic means we are as yet unable to demonstrate with mathematical certainty some endogenous disturbances, in the light of our present knowledge of physiology no form of obesity of a true pathologic nature can develop without some interference with metabolism?

That this concept is gaining ground need astonish no one. Thus Hutton[1] expresses

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his belief that the old classification into exogenous and endogenous obesity is probably incorrect, at least in the overwhelming majority of cases.

Pfeiffer[2] concedes that hyperalimentation does not seem to be of an exclusively exogenous nature. He points out that the size of intake is regulated in normal beings by a series of general sensations, which adapt it to the needed consumption. If food is taken for a long time beyond that need, this must be caused by an alteration of the general sensations. These he believes to be due to certain stimuli and reactions of the central nervous system.

Endogenous Type

The so-called endogenous type of obesity represents the most striking group and arouses special interest. In this group of obese patients, a disturbed metabolism can be demonstrated as the underlying factor.

Endocrinology today affords an exact means for studying its relation to biochemistry and has already thrown a flood of light on the pathogenesis and rational therapeusis of obesity. It is known today to a certainty that the hypophysis, the thyroid, the adrenals, the gonads and to a certain extent also the pancreas, singly or in combination, play a role in that form of disturbed metabolism which leads to the development of obesity, in addition to many other influences on the system which need not be enumerated.

Idiopathic Type

As regards the so-called constitutional type, the designation "idiopathic" would seem correct for the time being.

It has been customary to classify in this group all cases of obesity in which responsibility has been thrown on certain constitutional "diatheses." Certain racial characteristics, peculiarities of diet, hereditary influences and the like have been regarded as underlying factors. In the light of what has been said, it can be readily appreciated that all such explanations are at best vague in nature.

The idiopathic, as the exogenous form of obesity, has not been established on a scientific basis, and it too, may be abandoned in favor of a concept of faulty or disturbed metabolism, in many instances due to some endocrine dysfunction.

Trophic Type

To the last group—the trophic—may be assigned such well-known affections which differ from the usual type of obesity, in that the accumulation of fat is as a general rule restricted to certain parts or regions of the body. Dercum[3] has first described the disease named for him, which is also known as *adiposis dolorosa,* and Froehlich was the first to give us his syndrome also known as *dystrophia adiposo-genitalis* and as cerebral adiposity. Diffuse symmetrical lipomatosis as well as lipodystrophy may also be incorporated in this group, as kindred affections.

The etiology of the remaining affections is still obscure, but it is reasonable to assume that with the greater development of our diagnostic facilities it will be discovered that they too are caused by endocrine disease. Whether such a disease be due to injury, tumor or hemorrhage of the central nervous system is still an open question, but whatever the prime cause, it is conceivable that abnormal fat deposits can take place only when metabolism is interfered with by dysfunction of one or more endocrine glands.

If this be so, and there is no proof to the contrary, then the classification above given has no scientific justification and one can safely regard virtually all forms of obesity as endogenous or metabolic in nature and due primarily to endocrine dysfunction. Strange as this may sound to many who have come to accept the time-honored concepts, this statement is based not only on the arguments that have already been submitted, but on analogy. It is not uncommon to observe that patients are placed on high caloric diets or even subjected to over eating for the purpose of gaining weight, without the desired effects. Eliminating in such cases the presence of hyperthyroidism in any form or degree, one is inclined to believe that a faulty hypophyseal function is a causative factor. That certain diseases of the hypophysis may produce emaciation along with other symptoms, is illustrated in a magnified form in the so-called Simond's disease-*cachexia hypophyseopriva.*

As this affection is not even mentioned in some of our latest and best text-books on internal medicine, it must be defined in a few words. It is a metabolic disease due to sudden and complete cessation of functions of the hypophysis. Clinically the disease mani-

fests itself variably. Depending on what portion of the gland is affected, one notices either symptoms of acromegaly or diabetes insipidus. In any event the most striking characteristics are increasing meagerness to the extent of extreme muscular atrophy. In addition, one can observe retrogression of the sexual organs, hair and nails. Sexual function disappears, the *psyche* changes into apathy or form of idiocy. In spite of all attempts to overfeed, the condition terminates by death in the course of a few weeks or months.

As this clinical picture can be produced artificially in animals by the total extirpation of the hypophysis, the role of the hypophysis in obesity is established beyond a shadow of doubt.

Pathogenesis of Obesity

To attain a clear idea of the relation of endocrine dysfunction to obesity, one should first be agreed on the influence of the ductless glands on metabolism.

Beginning with the thyroid, we know today as an established fact that its secretion plays a decided role as a regulator of metabolism. We know that in hyperthyroidism, to cite an example, the basal metabolic rate is greatly increased. As a matter of fact, few surgeons venture to operate for toxic goitre or Basedow's disease, and no progressive internist undertakes to treat thyroid disease without first having ascertained the oxygen-consumption of the patient at rest—the basal metabolic rate.

It is also known that a whole train of phenomena and affections resulting from lessened function of the thyroid gland will be accompanied by a lowered metabolic rate.

The basal metabolic rate is, therefore, one of the most essential and legitimate diagnostic measures to be ascertained in all forms of disturbed metabolism, and, therefore, also in obesity.

While it is true that many obese persons do not show a greatly changed rate or occasionally even a normal metabolic rate, such a finding, too, is of importance, as will be shown later.

Wang, Strouse and Saunders[4] have shown that less fat is burned up in the obese than in normal persons; in other words, that in obesity there is a tendency to storing up fat. Castex and Schteingart[5] have shown that the basal metabolic rate was abnormal in about fifty per cent of one hundred obese persons, and that in almost every one such case, one or more glands were found to be defective. In the majority of instances the thyroid gland was the one especially concerned.

It is noteworthy that the observations of Wang, Strouse and Saunders have been checked and confirmed by Hagedorn and his collaborators[6] who further point out that in obesity there is an abnormal transformation of carbohydrates into fats. This latter observation does not controvert the relation of the thyroid to metabolism, for, from a purely practical point of view, the exact chemical changes in the body have only a secondary importance.

Pituitary obesity seems to affect young persons. Thus Gardiner, Hill and their associates[7] have found that in a series of 60 cases of adolescent obesity due to pituitary dysfunction, 68 per cent had an abnormally low basal metabolic rate. Plaut[8] confirms this finding also in other forms of pituitary obesity.

The part of the pituitary body that is affected plays a decided role. Thus it is seen that in Simmond's disease we can observe either symptoms of acromegaly or of diabetes insipidus. The former takes place when the anterior lobe is irritated while the polyuria has been shown to occur only when the irritation affects the middle lobe.

Masterman-Woods[9] claims that the obesity of pre-adolescents is due solely to insufficiency of the posterior pituitary. While this form of obesity resembles the myxedema seen in thyroid deficiency, it differs by the apron-like development of fat in the lower abdomen. It is known that in true myxedema the face, neck, chest and abdomen are generally involved.

The same author has found in young obese persons abnormal curves of blood sugar which responded favorably to administration of extract of the posterior pituitary lobe. It is established that aside from the influence of the secretion of the pituitary gland on the growth of bones, it has also a decided influence on the metabolism of fats and other hydro-carbons, in which latter the posterior lobe has an especial influence. Gardiner and Hill, cited above, have published a series of

60 cases of adolescent obesity with underlying disturbance of carbohydrate metabolism, the accumulation of fat being pronounced in the hips and shoulders.

The influence of the anterior pituitary lobe on obesity has been demonstrated experimentally by Paulesco[10]. This investigator has been able to produce obesity in animals by removal of the anterior lobe. From a clinical standpoint the labors of Langmead and Calvert[11] and Maranon[12] show that obesity immediately follows injury to the middle and posterior lobes.

It cannot be maintained that the observations of the qualified observers as well as those of my own are conclusive in every respect. Thus it is not yet absolutely clear why localized adiposities follow dysfunction of the pituitary gland, that is, as far as each division of the gland is concerned. While these details require additional research, the general fact that dysfunction of the pituitary gland has a decided influence on the production of general or localized deposits of fat in the young and adults is established experimentally and clinically beyond successful contradiction.

Long before modern endocrinology became a recognized discipline of medicine, there was general knowledge that the gonadal glands in some way affect the human economy. Adolescence, puberty, sexual maturity and senility all left their mark too plainly on growth, the voice, and the nervous system, to be appreciated even by the ancients. Applying the more modern views to this problem, Kisch (quoted by Dickenson and Cary[13]) observed excessive adiposity among 215 women, 75 per cent of whom had scanty or no menses, while 21 per cent were sterile. Dickenson and Cary further established the interesting fact that in men, suffering from azoospermia with corpulence, reduction of the weight was followed by the appearance of live spermatozoa. Masterman-Woods points out that in uncomplicated hypogonadism obesity is confined to the mammae, to the sides of the body from the axillae down to the crests of the ilia, to the pubic region and to the upper and outer thirds of the thighs.

It is a common experience that women whose ovaries have been radically ablated develop phenomena which are virtually identical with those of the menopause. Adiposity is also commonly observed in male castrates and in those in whom sexual activity has been suppressed for one reason or another.

In *dystrophia adiposo-genitalis* or Froehlich's syndrome, there is an interrelation between pituitary and gonadal dysfunction, great corpulency accompanied by atrophy of the genitals, often also with changed sex characteristics.

Something might be said here with reference to many young women of modern times who show an inclination towards adiposity or even a development of obesity without any apparent specific endocrine dysfunction. In the class of this type under observation, the fact was easily elicited that almost all of them gave a history of restricted child bearing. Might it not be that the suppression of the natural function of reproduction and the failure to utilize the resources for the bearing and nourishment of a fetus *in utero* tends to divert the pent-up fluids and energies into the woman's organism, where they build new fat tissue In other words, it is the author's purely theoretic concept that in such cases we deal with (what for want of a better term, may be called) "inverted castration," resembling in effect the obesity seen after natural or artificial (surgical) menopause.

The influence of the adrenals is evidenced by the fact that when obese persons are given injections of epinephrin they do not produce the same rise in the respiratory quotient that takes place in the normal persons.

The rôle of the pancreas is shown by the well-known connection between diabetes and obesity. Studies substantiating the direct relation of disease of the islands of Langerhans and fat metabolism are too well known to require recital at this time. Of special interest in this respect is a contribution by John[14] of the Cleveland Clinic. In a series of 12 cases a glucose tolerance test showed a diabetic or pre-diabetic condition in no less than 42 per cent of the series. John properly emphasized the importance of investigating the glucose tolerance for the purpose of determining the presence of diabetes or of a tendency to diabetes. Paullin and Sauls[15] likewise found in 26 cases of studied obesity an abnormal glucose tolerance in nearly 58 per cent of their series.

Diagnosis

With what has been said about the etiology and pathogenesis of obesity in mind, there is little that need be added about the diagnosis.

It may not be amiss here to emphasize that the present tendency on the part of many women and, for that matter, even men to seek medical advice solely for the purpose of undergoing reduction, should be checked with every means at the command of the physician. The patients have, of course, the right to demand of the physician that he aid them in getting rid of superfluous fat, but it is the physician's duty to instruct the applicant that obesity is not a simple matter which can be overcome by routine measures. If the patient refuses to undergo the essential diagnostic tests and to submit to any course of treatment that the diagnostic evidence may indicate, the physician will do well to decline treatment. It has been my experience as doubtless, it has been that of other physicians specializing in endocrinology, that while one occasionally loses such a patient, he or she will invariably return later. They will have failed to benefit from routine dietetic prescriptions and indiscriminate medication at the hands of practitioners willing to treat the patients on their terms. In the long run such failures give rise to severe criticism by the very patients who have been properly advised and should have known better.

It may sound trite, but it is a truth which is often enough ignored, that the obese patient is sick, and must be so regarded by the conscientious practitioner.

To arrive at a real diagnosis a careful history followed by an exhaustive general physical examination is as essential in any and all forms of obesity as in all other general diseases. Very little information is derived from a mere inspection of the patient, from a charting of the height and weight. The most innocent looking obesity may be due to more or less serious glandular defects and these must be sought with care or excluded.

The examination of the entire body having been completed, the next step to be taken pertains to the determination of the metabolic rate. This is performed in the usual manner, that is, early in the forenoon on an absolutely empty stomach and with the patient having rested from the trip to the office or laboratory.

While a routine chemical analysis of the urine is never omitted, the absence of a reaction to any of the standard tests for sugar has no positive value. Expert blood chemistry is of paramount importance.

The glucose tolerance test should be carried out in each case, where pituitary obesity is suspected.

Finally, no examination should be regarded as complete until the *sella turcica* has been examined by a qualified roentgenolgist, preferably in stereo.

The methods just enumerated are costly, but necessary. Even with their aid, the establishment of a true diagnosis is a matter of a good deal of experience and judgment. This cannot be treated in a brief review.

Therapy

The proper therapy is dictated by the diagnostic findings. Let us first take up the type of obesity which has been described by most authors as exogenous. If in spite of careful search one is unable with our present diagnostic methods to find any endocrine disturbance, the metabolic rate is normal, the blood chemistry is normal and nothing in the history of the case and in the physical examination or on the X-ray plate shows any abnormality, the physician still has the means to accomplish much good. In such apparently simple cases of obesity the advice to be given should be educational in nature.

The diet must be not only restricted, but well balanced. Starvation methods are to be rejected for several reasons. In the first place, such harsh measures are not at all indicated, nor can it be assumed that men and women have the will-power to carry them out consistently, even if their necessity be admitted. The danger from acidosis is also too real to be ignored.

Individualization is the keynote to success. Not all obese persons without demonstrable basis can be given one and the same advice. Everything must be graded to meet one's age, peculiarities, habits, occupation and the like. Whatever amount of calories and quality of food are decided on, should be written down and the patient cautioned emphatically to carry out all orders carefully, occasionally even to the weighing of the food. The physician should remember that in most cases of obesity there exists a vicious circle with reference to the intake of food in relation to the body weight. While overfeeding aids in the development of superfluous fat, obesity blunts satiety and produces an ever-increasing desire for food. Here, then, gradual but strict reduction in quantity must be regulated at

first to appease somewhat the abnormal craving for food.

If it be recalled that obese persons exert greater energy in one and the same exercise performed by normal persons, this, too, requires careful graduation. Even though the routine examination consisting of auscultation, percussion, cardiography, and blood pressure has shown the circulatory apparatus to be normal, it is safer to go slow, especially in individuals of sedentary habits. One should begin with short walks and increase the length to be covered from day to day by adding short distances.

In this, as in all other forms of obesity, the patients should be cautioned from the very beginning that rapid reduction is not to be sought. If an adult patient, say in the forties or fifties, lose only one or two pounds per week until the desired amount has been attained, he or she will do well. Two pounds per week may be lost with impunity but we doubt the rationale of reducing more than that.

Finally, after the desired weight has been attained, the patient, who should report at least once a week, especially when organotherapy has been added on general principles, must be told that eternal vigilance is the price of health. In other words, this type of patients can never go back to their old quantities and quality of food. A break in the diet may and should, however, he permitted two or four times per month.

The only drugs that are of specific value in this class of obesity, are thyroid and pituitary extract. There need be no fear of any ill consequences in spite of the generally prevalent idea that it is a dangerous remedy. It goes without saying, however, that only small doses should be administered and its effects be checked at every visit.

A point of great importance, which applies not only to thyroid extract but to all organic preparations, is, that the physician know the quality of the brand he uses. Not any two preparations of the same kind are equally standardized. Thus, in thyroid extract, the thyroxin equivalent is of greatest importance. It is or should be generally known that one reputable house may assay one percentage, while another equally reputable house will manufacture the same product but with a thyroxin content many times stronger.

The general directions given for the so-called simple form of obesity apply to a great extent, also, to those forms in which the underlying factor or factors have been determined. In these, of course, in addition to the dietetic regimé and exercise, we are in a position to employ a more or less specific method of treatment.

In obesity even palpably due to thyroid deficiency, large doses of thyroid extract are never indicated. Exact dosage cannot be given for all cases, the basal metabolic rate and the frequency of the pulse being the best guides. The basal metabolism must be determined from time to time in the course of the therapy, and this, as well as the well-known phenomena of thyroidism, will determine changes in the dosage and frequency of administration.

Mention was already made of the administration of extract of anterior or posterior lobe of pituitary gland in the frankly pituitary forms of obesity.

In the gonadal form of obesity, experience has shown that thyroid extract alone or in combination with other organic products, especially pituitary extract, is frequently effective. In women, ovarian extract may be added to advantage. In this type, hygienic advice with reference to sexual habits has a decided place.

The very nature of pancreatic obesity points to the utilization of insulin and to anti-diabetic diet.

These general rules for treatment presuppose constant control on the part of the attending physician, whose duty it is to check the progress by physical examination and by the laboratory tests mentioned above in the section on diagnosis.

In the European as well as American literature physical therapy has been advocated in the treatment of various forms of obesity. Personal experience based on exhaustive trials as well as on personally communicated expressions by authoritative observers, in this special field, leaves no doubt that the results are discouraging. Of the physical methods suggestive of some value as an adjunct to the treatment outlined above, ultraviolet radiation under proper control holds the highest place. The abuse of that form of physical therapy leads to more harm than good.

Finally, mention is made to condemn the pernicious use of all sorts of magic waters and pills with an alleged radium content, by

a certain class of unscientific physicians. In this category belong the dangerous undertakings by a few European and American surgeons and self-styled plastic surgeons who by one method or another broadcast the fact that abnormal adiposities can be corrected by surgical ablation. The known tragic results following such scientifically unwarranted procedures should suffice to warn the general medical profession against the sanction of such mutilating methods.

Summary

1. Obesity is a pathologic entity due in the overwhelming majority of cases to metabolic disturbances.

2. The abnormal accumulation of fat in any part of or throughout the body is merely an objective symptom.

3. In addition to the adiposity a train of variable symptoms undermine the general health of the obese individuals.

4. Symptomless accumulation of fat in moderate quantity is not a true pathologic condition.

5. The diagnosis of obesity must be based on the pathogenesis of each individual case and involves a thorough physical examination and a special examination directed at the determination of glandular defects underlying the particular type of obesity at hand.

6. The treatment must be directed against each obese individual as a clinical entity and entails not only appropriate dietetic control and specific medication, but educational direction of hygienic living.

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Discussion

DR. VICTOR E. LEVINE (Omaha, Neb.): Dr. Kern has mentioned endocrinology so often that I think we might elaborate a little bit more in the few minutes at our disposal. There is no doubt that all the methods we have tried are not as successful as people would have us believe. There is, however, this fact present, that the endocrines are being injured more and more, and I want to mention two things about this injury.

We can keep our weight with 1000 calories, and even less, and the reason is that one of the important factors in the injury of the endocrine glands lies in malnutrition. Improper diet is one of the most important factors in injuring the thyroid, pituitary and other glands. Hence, on a low calorie diet of 1000 calories, or even less, a vicious cycle is established, and this vicious cycle keeps on and on.

I have been told by an anthropologist that many years ago the human being was much less in weight. This increase of weight which goes on with increase in age is a product of modern civilization, but the ideal individual weighs the same at fifty or fifty-five as he did at twenty-five. So we might say that this increase in weight is a reflection of deterioration which goes on in the human race. Not only the question of diet is to be considered, but also the question of this increase in activity, this hyperactivity of the average individual is bound to injure the glands of internal secretion which furnish the pep, the drive, or the push of the individual, and these may be used to such an extent that they will suffer more or less fatigue.

We don't have the problem of gluttoning. One hundred years or three hundred years ago, if you read the novels, you will find that the king and queen sat down to a table groaning with all kinds of foods. You have a very good example in Henry VIII. His physical proportions attest to the fullness of the dietary procedure which went on in those days. By 1850, the formal repast had come down to eighteen courses, and by 1880 the formal repast had come down to twelve courses, and by 1900 the dinner was cut down to six courses. It took us a long while to catch up to civilization in the matter of eating. As a matter of fact, we eat much less than we did one hundred years ago, or even fifty years ago, and, in spite of the fact that we eat much less, the problem of obesity is becoming more and more acute, or perhaps better known. The only explanation we can give from the standpoint of this discussion is the injury, the insult which is heaped upon the whole endocrine system: first, through the use of improper food; second, through hyperactivity of the individual.

With reference to basal metabolism, we cannot rely upon one single determination. I think Dr.

Kern has brought this out. Time and time again you will find a patient in an emotional disturbance, or out of gear with his surroundings, with reference to the basal metabolism, and you may find a metabolic rate which throws you off. In order to get good results, results that will be subjected to judgment and criticism, we have to have a series of metabolic rates. We don't rely upon one blood specimen; we don't rely upon one urine specimen, and some physicians don't even rely on one Wassermann. It is almost senseless to base a diagnosis, unless there is also a very, very great extreme to one side or another, of endocrine deficiency on one single basal metabolic rate.

I am inclined to believe that as time goes on the value of endocrinology with reference to obesity will loom larger than it has before.

In talking about exercise, it is the most foolish thing we can think of for reducing. If you want to get rid of one piece of pie you have to walk five miles. You only use up about 500 calories in a six- or seven-mile walk, and you would have to do a tremendous amount of walking. You would actually have to go to a lumber camp in Maine in order to take off the extra few hundred calories which would bring about this increased condition. It is therefore not a question of exercise; it is not a question of diet. Obesity is a question of wrong living. It isn't a question of poundage. It isn't a question of how many pounds you have increased or what size you are now wearing. The whole question is summed up in the fact that if we assume correct living habits from the standpoint of activity, from the standpoint of emotional expenditure, from the standpoint of rest and relaxation, then the problem of obesity will be a problem that will disappear.

Dr. James H. Hutton (Chicago): I am in accord with the opinions expressed by Drs. Kern and Levine on the problem of obesity.

I want to endorse especially what they said about the use of the basal metabolic rate and about its unreliability as a single factor or single standard which would determine the state of the patient, whether he might or might not need thyroid.

Some years ago I was a medical director in a school of about 300 girls, drawn from all over the country. Nearly every year we had a patient that developed acidosis due to a so-called reducing diet. Usually, these young ladies were only a few pounds overweight. This one-sided type of diet usually precipitated a state of acidosis. Diet is a thing that has lent itself to fad, fancy and changing fashions of all kinds.

The diet in diabetes has undergone radical changes. In the case of a diabetic, a few years ago, we promptly took away his carbohydrates, and he promptly went into coma and died. Later, we found that fat had something to do with it, and we were inclined to be slow in removal of fat. Now, we hear about the low carbohydrate and the low protein and the high fat diet, and they get along well. As a matter of fact, of course, the diabetic has a crippled pancreas, and any diet that does him very much good has to be fitted to the state of his crippled organ. If he is able to live with just part of his organ functioning, he needs no insulin.

The matter of obesity is of interest to me only as it involves the state of the person's health, not as it involves his cosmetic fancies. Except with the idea of improving his health as a result of his reducing his weight, I think I shouldn't be interested in the subject.

A good many research workers—I think particularly the research workers—tell us that obesity is a matter of diet; purely a matter of too high a caloric intake. It seems to me that their own results from their work proves their statements are not correct and, as a matter of fact, our own common sense and our own observation tells us they are not correct.

I doubt if there is a person in the room who doesn't know one or two people who are overweight anywhere from twenty-five to seventy-five pounds, and whose caloric intake does not exceed that of their thin friends. You probably know a lean husband who is married to a fat wife, and the lean husband will eat twice as much as the fat wife does, or vice versa. So it seems to me that common sense alone indicates that diet is not the only thing involved. There is no question that there are a lot of people who are overweight because they eat more than they can take care of; purely a matter of storing up an excess of intake.

The best example of that and its relation to exercise is furnished by a recent study of a large group of railroad employees. The chief surgeon of one of the railroads of Chicago undertook an examination of the operating employees. About 10,000 were examined. The locomotive engineers furnished about ten per cent of the total employees examined. Fifty per cent of the hypertension, fifty percent of rheumatic diatheses, fifty per cent of the bad teeth, fifty per cent of the Graves' disease, the goiters, were found in this class of employees. It was found that they were taking as high as 15,000 calories a day.

An engineer is not always an engineer; he is first a fireman. He does a lot of hard work; he spends a lot of energy; he is subject to high temperature; he is subject to rapid changes in temperature, and he acquires an enormous appetite. But he doesn't gain in weight. When he is promoted to engineer he crosses to the other side of the cab and sits down. He does very little physical work, but takes his appetite with him. What we eat is largely a matter of habit. We don't eat what we need, but what we want. The stomach is called the biggest liar in the body. It gets used to handling a certain amount of food and isn't happy unless it handles the same quantity regardless of what we need.

I want to emphasize a point that Dr. Levine made, and that is when a basal metabolic rate is being taken, the lowest reading that you find is undoubtedly the correct reading because any error in the preparation of the patient or in the performance of the test will lead to error on the plus side. There is only one error that I know about that tends to make the rate lower, and that is, if the soda lime does not absorb the carbon dioxid, the

rate tends to be a little lower than it ordinarily would be.

We find that the pituitary type of obesity is nearly always accompanied by a low blood sugar and by high carbohydrate tolerance. Following the oral use of pituitary preparations or pituitrin hypodermically, you will find that the appetite tends to disappear and the blood pressure tends to rise a little bit, but if you test the carbohydrate tolerance you will find it isn't so great as it was originally.

It seems to me that pituitrin has a tendency to keep glucose in the blood stream a little longer, or give the body a chance to oxidize it instead of storing it. An obese person of the pituitary type can be given a diet. They lose weight to a certain level and then they stop. You can then institute the use of pituitary preparations either by mouth, hypodermically, or both, and the loss of weight is promptly increased. You can stop that and they may gain to a certain level, or increase in weight a little bit. You can resume the use of the pituitary preparations, and the loss of weight occurs again. By that sort of intermittent medication, you can with certainty determine that it is a pituitary type of obesity because it yields to that type of therapy.

We have a number of tests for pituitary cases. There is the lactose tolerance, the nitrogen-partition, and the vital capacity.

I will mention a very interesting test because it is so much simpler, so much more easily performed than the old glucose tolerance test. A woman, for example, as reported, had a tolerance before puberty of about twenty grams; an adult woman during an active sexual life had about forty grams of lactose, and after menopause it will sink again to about thirty grams. You can easily give these persons thirty, forty or sixty grams of the lactose, collect the urine over four-hour periods, test it for sugar, and you are certain to determine their sugar tolerance.

The pituitary case usually has a high blood uric acid, the other nitrogenous constituents of the blood being normal. The dosage of pituitary preparation, also, has to be gaged by practice rather than by laboratory work.

The so-called gonad obesity is entirely a different proposition. It usually occurs at the menopause, or is accompanied by some menstrual disorder that gives us a clue of the endocrine at fault.

DR. OLSON (Battle Creek, Mich.): I wanted to mention that from my own observations over a good many years, obesity can be controlled in a vast majority of cases by dieting. I listened to a very interesting discourse by Professor Newburgh of the University of Michigan last winter, and his presentation was very much in line with my own personal experience.

If your man doesn't eat enough to supply his energy he must utilize it from the fat that he has stored up in his body. If one does this by providing a well-balanced, carefully selected diet, I believe it can be reduced in the vast majority of cases and with not too much exercise.

I think exercise can be overdone, but I do believe, as one writer has put it, the most important exercise for patients who are obese is the exercise of pushing themselves away from the table just three times a day.

CHAIRMAN ELSOM: You have all heard, no doubt, the degrees of obesity: first, enviable; second, comical, and third, pitiable.

It seems to me, as a matter of fact, that all cases of obesity are pitiable. None of them are enviable. There are the two classifications that an English writer has given us: one, alimentary; too much intake and too little oxidation. That is a common, ordinary variety of obesity which we are perhaps all familiar with. The other is the endocrine variety.

I want to point this out to you, that obesity is altogether an undesirable condition. As someone has said, it is the consistent confederate of all the deadly diseases, and I believe that is true. An obese person is more liable to have trouble with the cardio-renal system, the liver, the digestive apparatus. In fact, every one of the organs of the body are affected by undue obesity.

As to diet and exercise, of course, there is a great deal of difference of opinion, but I think less and less are we believing that diet and exercise is the only factor in the relief of obesity. In fact, this English writer, to whom I have just referred, believes that in the treatment of obesity the patient should be put to bed instead of being exercised, and that is rather a novel method of treatment.

I want to emphasize, also, what I think Dr. Levine said, or some other discussant, as to the added weight which we are supposed to take as we grow older. Now, why should we grow heavier as we grow older? It is because of the fact, as Dr. Levine I think has said, that it is an incorrect method of living.

Again, going to rather an unusual form of treatment, many German investigators lately have been using the ultraviolet as a factor in the relief of obesity. Perhaps this has merit. I don't know, but if we believe in the stimulation of the endocrines by ultraviolet, I think, possibly, we have a potent factor in properly used ultraviolet radiation. It is being investigated just at present, but with what result I do not know.

Let me say this: That the relief of obesity is not as someone has facetiously said, to open up another button, but the treatment is to prevent its onset. That is much easier than it is to get rid of the excessive fat when once it has been obtained. So we give this advice: One of the best things in obesity is to keep your mouth shut and your bowels open.

ARCHIVES of PHYSICAL THERAPY, X-RAY, RADIUM

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NINTH ANNUAL SESSION, SEPTEMBER 8 TO 12, 1930, ST. LOUIS

EDITORIALS

LAST CALL FOR ANNUAL SESSION

This is the last call for atendance at the annual session which this year will be held at the New Hotel Jefferson, St. Louis, Missouri. The week of September 8th will be given over to an intensive study of physical therapeutics in all its branches. The program will be conducted on a post-graduate basis, but fundamentals will be stressed so that the physician unfamiliar with the uses of light, heat, electricity, massage and therapeutic exercise will obtain good ground work for further study. The talent secured for this year's program is of such calibre that it would be extremely difficult to surpass it anywhere in this country or in any other country. The variety of subjects, the clinical sessions, the demonstrations, the sectional gatherings, the exhibits and informal conferences will lend an atmosphere of scientific study such as has not been observed before in a meeting devoted exclusively to physical therapy.

The American Congress of Physical Therapy is primarily interested in one objective—the promotion of scientific physical therapy. Its aim is to conduct its yearly sessions on a high plane and in accordance with accepted teachings on the subject. Every effort has been expended to secure the services of experienced teachers and clinicians, and the preliminary program which includes the names of outstanding men in the profession is a tribute to the progress which physical therapy has made through the work of the Congress.

The annual sessions of the Congress are open to all recognized members of the medical profession and to their assistants and technicians properly vouched for. All specialties are represented and sectional meetings are conducted in medicine and the medical specialties in surgery and the surgical specialties, and in eye, ear, nose and throat. These sectional gatherings make it possible for the physician to concentrate on the specialty in which he is most interested without loss of time attending lectures or demonstrations on subjects remote from his daily work. The classes which this year will be more or

less clinical in character are likewise divided into sections. The instruction classes are scheduled for the mornings and the scientific papers and clinical addresses for the afternoons. There will be no evening sessions, except the one on Monday which is for fellows of the Congress and the transaction of routine business.

Fellows of the Congress are urgently requested to make every possible effort to attend this annual convention. Bring your colleague, your associate or your assistant. Cooperate with the officers of the Congress to make this gathering one which will long be talked about by those who attend. Put your shoulder to the wheel. The Congress cannot function successfully unless there is a unified effort. You need the Congress if you are at all interested in physical therapy, but the Congress needs you to aid in solving the many problems which constantly confront it, to assist in clean propaganda, and to disseminate authoritative information concerning the theoretical and practical problems which arise in every-day work.

There are numerous medical organizations to which we give our support. Some merit it, others attract it for various reasons but are not worthy of our cooperation and interest. The American Congress of Physical Therapy has made a persistent struggle. Solid effort, clean propaganda, good scientific presentations supported and conducted by conscientious and sincere members of the medical profession have made this organization wholesome and progressive and the leader in attainment in physical therapeutics. The annual conventions have always been well attended because they are carefully planned for the benefit of those who leave their work to further their knowledge in this new branch of medical treatment.

This is the last call. Only a few weeks remain before the first clinical class will be called to order. If you have not already planned your attendance, do so *now*. Send in your registration by mail. Write to the New Hotel Jefferson and make your reservations. St. Louis is a beautiful city for a convention. Every minute that you will spend there will be interesting, enjoyable and beneficial. COME TO ST. LOUIS FOR SEPTEMBER 8TH.

NEW ISSUES FOR OLD

Sporadically, the older and fundamental issues of the effectiveness of high frequency currents are revived and there is much ado in regard to it. Within the past several years a series of investigations as well as some theoretical and speculative discussions have arisen in American literature tending to prove or disprove the penetrative values of high frequency currents. The results have in the main been completely inconclusive. As many have found positive effects as negative. In the majority of instances these experiments have been carried out by novitiates in medicine and in the field of physical therapy. They were prompted as much by the spirit of medical adventure as by the illusive glamour of quick reward. As was expected, the issues created by these reports have further cluttered the progress of high frequency therapy and, by virtue of the large publicity that they received, it has clouded the issue still further. These reports have been considered as deeply scientific by many who were without authority to pass judgment. In reality their work consisted of a series of muddling and superficial experiments. Shallow waters are frequently misjudged for great depth because of muddy qualities: the soundness of some of these experiments were interpreted as valid because of the scientific verbiage that clouded them. Attention has frequently been called to this subterfuge through the columns of the *Journal of the American Medical Association*. Nothing so readily impresses the mind of the average reader, whether physician or layman, as a generous display of words of pseudo-scientific character. In a situation of this nature the uniformed reader is attracted frequently by a first impression. But it also has the sharp and quickening quality of a whip. It stimulates thinking and discussion.

The end-result of these studies on some of the phases of high frequency current have, in reality, been constructive. It awakened, again, new interest in these issues. It has stimulated certain qualified scientists to revaluate not only the problem of frequency in relation to the human body, but also the effect of high frequency current on various tissues of the living body. Seldom is such an undertaking without profit to the problem. The by-products of many an investigation has taken leadership as a result of the newer light it has thrown on the issue. An example in

point are the recent studies of Bachem [1] published elsewhere in this issue. They were prompted by an attempt to revaluate Wildermuths [2] investigation on the specific heat resistance of the human body to high frequency currents. Certain apparent weaknesses in the latter work suggested a departure from the older method. It resulted in a valuable contribution. Bachem made use of living material (in vivo) and material that approximated the living tissues very closely. As a result of this it again established the fundamental work of Wildermuth, proving thereby, that the skin has a lower resistance to high frequency currents than to low. It further confirmed the theories of Von Nernst [3] and McClendon [4] that the lower frequencies have an ionic effect and the higher an electronic; that one produces gross movements in electrolytic solutions, the other pronounced atomic activity.

Another suggestive phenomenon was disclosed which also has an important bearing in the future interpretation of lung inflammation. It was demonstrated that a pronounced variation in resistance existed between normal lung tissue and collapsed. Lung cells in the condition of inflation are permeated with air pockets which heavily resist the passage of a diathermy current. Collapsed and hepatized lung tissue permits of a more ready passage for high frequency current. It is not at all unlikely that the beneficial effects of diathermy in pneumonia may depend more on the penetrative quality rather than on the heat. We leave this intriguing speculation for others to demonstrate.

Stenstroms [5] recent studies in regard to high frequency currents may or may not have been prompted as a result of any existing polemic. Whatever the stimulus, the report is timely and adds to the positive contributions on the biophysical interpretation of the phenomena of high frequency currents. As with Bachem, so also with Stenstrom. His investigations are, however, a branching off from studies initiated by earlier pioneers in the field. Amongst the earlier contributions to the problem of frequency were those presented by Tesla and d'Arsonval. Since that time sporadic attempts have been made by many representative investigators to prove the specificity of certain regions of frequency.

Within the past few years even the ultra-high frequency currents were studied and certain specific effects were attributed to them. Schereschewsky's [6] claims for the specific lethal value of certain extra high frequencies applied to tumors were short lived. On the heel of his published reports there followed the work of Christie and Loomis[7] which disproved any specific effect of the frequencies mentioned by Schereschewsky. They demonstrated that the lethal effect was entirely due to the heat value. In the presence of the existing knowledge in regard to the frequencies utilized in diathermy, no other valid claim can at present be made than that advocated by Stenstrom; namely, that the lower frequencies (500,000 to 1,000,000) merely stimulate the tissues to a quicker heating than the higher frequencies, (1,000,000 to 3,000,000). Proof that the penetration is deeper or superficial, or that it varies with frequency, is still a debatable issue and belongs to the realm of conjecture.

It is to be regretted that the average clinician's background is such that he feels himself incompetent to critically review and interpret work of a biophysical nature. Herein lies the weakness of modern medical education. There is a need for more organized studies in the field of electrophysiology. The faculties of the modern medical universities are cognizant of many shortcomings in present teaching methods. They are gradually so shaping their programs as to incorporate the newer advance teachings in radiology and physical therapy. Their conservatism is not an index of their mental resistance to the progress of the times. It is their desire not to graft a new discipline on the already overcrowded curriculum but rather to gradually incorporate it in the manner that it will eventually be a part of the whole discipline of modern medicine.

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KNIGHTHOOD CONFERRED ON PROFESSOR LEONARD E. HILL

The many American friends and admirers of Professor Leonard Erskine Hill will be gratified to learn that high recognition has been accorded him by His British Majesty. The well deserved honor of Knighthood has been conferred upon him as a token and reward for the many years of brilliant labor in the field of science. Sir Leonard has for many years occupied a position of high distinction in his own country.

We are pleased to quote from a friendly comment, published in the July issue of the *British Journal of Actinotherapy and Physiotherapy.*

"The honor (of Knighthood) is not only well deserved in itself, as the crown of a most distinguished career, but is a confirmation of the rightness of his attitude in the recent storm over ultraviolet light created by the unfortunate Report of the Medical Research Council. It is an open secret that Sir Leonard did not agree with the methods adopted and conclusions arrived at in that report; being sufficiently independent to express his views, he brought on himself the wrath of some of the "powers that be." But his fearlessness will always be counted to him for righteousness. It earned him the admiration of all who knew the circumstances, and the courageous stand he made is very suitably recognized by the conferment of the honor of knighthood.

Sir Leonard's career began with a series of academic distinctions, leading to various important lectureships and examinerships, and thence to a Professorship of Physiology in the University of London. He was then appointed Director of the Department of Applied Physiology at the National Institute of Medical Research, a post he held up to June 30th of the present year. His work has always been connected with physiology and particularly with "applied physiology." During the war his opinion was constantly sought on the question of protection from noxious gases. He was also an authority on caisson disease as those who read lately of his work in deep sea salvage operations on behalf of the admiralty will remember.

While his work on these subjects was very important, it is probably by his more recent works on ventilation and ultraviolet light that he will be best remembered by the medical profession and the laity. The strictly scientific work is embodied in his "Science of Ventilation and Open-air Treatment" and "The Kata-thermometer in Studies of Body Heat and Efficiency," published by the Medical Research Council. But by his more popular writings (e. g., "Sunshine and Open Air," "Health and Environment," "Common Colds") and by his lectures on ventilation, fresh air and sunlight, he has done more than any other single advocate to popularize these subjects and spread a knowledge of their benefits from the highest to the lowest."

The realm of British Knighthood no doubt feels honored by the addition to its already distinguished list the name of this man.

We offer congratulations to Sir Leonard and wish him many useful and contented years on the eve of his retirement from the field of active labors. Like Prospero he will now bury his magic books and seek diversion in philosophic contemplation.

THE TONSIL PROBLEM AGAIN

Every once in a while the subject of treatment of diseased tonsils engages our attention. So many methods have been suggested that the laryngologist rather than experiment with something new and not thoroughly tried out prefers to adhere to the good, old surgical technic. The use of electrosurgery for eradication of diseased tonsils has not been placed on a scientific basis. It has been extensively employed, but in the main its application has been by general practitioners and not by specialists. In spite of clinical trial in hundreds of patients, the technic has not been standardized. There is no agreement on the type of current best suited, nor is there sufficient authoritative data to guide the inexperienced on the correct choice of procedure.

Electrocoagulation is the preference of those who have wrongfully adopted this method as a routine means of tonsillar treatment. Electrodesiccation is advocated by the more conservative who would not be too radical in attempting rapid destruction of tonsillar tissue. Coagulation dissection is more commonly the choice of the specialist who sees merit in electrosurgery but who still believes that the ideal plan is the complete removal of the tonsils at one operation. Just which procedure is the best is still difficult to judge, even though experience has been attained with all of them. It is quite probable that no single method is ideal, that the selection of one of the electrosurgical methods, if one is to be utilized, is dependent on the many factors which may be present.

That other procedures within the scope of physical therapeutics merit consideration is quite evident from a perusal of the medical literature. The application of radium has its advocates. X-ray therapy, although condemned by some, appears to possess sufficient worth in the hands of a specially trained few to call for fair evaluation. The time has come when the specialist must give every method due consideration before deciding which one is the best for the individual case at hand. Surgery is included in this category.

The case of a man aged 62 is in point. Because of hemophiliac tendencies surgical tonsillectomy was refused by several specialists all of whom agreed that the tonsils were acting as a focus of a severe generalized arthritis. No improvement of the arthritis made it imperative that some means be exercised for the removal of the tonsils. Electrodesiccation was performed, the tonsils destroyed, and the patient's arthritis practically cured. The statement of some specialists that there is never any occasion for means other than straight surgery for the removal of tonsils must be challenged. The case cited is a good average specific example.

There are indications which constantly present themselves for physical therapeutic procedures, common judgment pointing out their appropriateness over the cold knife. Certainly the destruction of recurrent lymphoid tissue after surgical tonsillectomy has been performed one or more times is best handled by electrosurgical methods. Unbiased experience bears this out.

That there is an increasing interest in electrosurgical treatment of tonsils is known by those who are employing this method. This interest is now manifested chiefly by laryngologists who have become open-minded and who are seeking the best means of managing pathologic tonsils which should not be submitted to the customary surgical removal. These same laryngologists are hungry for information concerning proper technic. They are present at every operating clinic and are disappointed when unable to observe one or more of the electrosurgical procedures.

The overenthusiasm for electrosurgical destruction or removal of tonsils which was manifested a few years ago has now settled on a more rational basis. There should be no controversy on the subject by fair and unprejudiced surgeons and specialists for the matter resolves itself finally in individualization of treatment. There is no question regarding the necessity of continuing surgical dissection and enucleation of toncils. No matter which means are suggested surgery will always hold first place. But electrosurgery is a definite advance and must be accorded scientific status as one of the practical and modern substitutes for the removal of tonsils when surgery is for some definite reason contraindicated. Narrow and prejudiced opinions based on nothing more than hearsay or theoretical knowledge cannot justly influence the situation. Experience and results support the contention that, when indicated and correctly employed, electrosurgery is a sound, rational and scientific means of removing diseased tonsils.

EVERY FELLOW OF THE
American Congress
of Physical Therapy
is urged to attend
the Ninth Annual Session
SEPT. 8 TO 12, 1930
NEW HOTEL JEFFERSON
ST. LOUIS, MO.

PHYSICAL THERAPY CLINICS

X-RAY TREATMENT OF SUPERFICIAL NEOPLASMS *

W. E. PENNINGTON

INDIANAPOLIS, INDIANA

The treatment of neoplasms has been discussed very frequently in the past and the history of its accomplishments has been very ably presented by different authors. The writer asks your indulgence in his personal views regarding treatment of superficial neoplasms.

The success of Roentgen treatment is very dependent upon the accuracy of the dose; the rapidity of the growth; the position of the lesion; the degree of inflammatory structures about the growth; the previous treatment and the physical condition of the patient.

There has been much discussion about fractional and massive doses. It is very evident that fractional dosages are much the safer and should be used where the lesion has become deep and where there is considerable inflammatory tissue. My experience has been that fractional dosage is very hard to control because of a marked cumulative effect on some patients and lack of it on others. If a dose is given once each week some of the patients recover from the results of the treatment very quickly, while others show a delayed reaction and will therefore get a cumulative effect from each of the fractional dosage.

I find the massive dose most efficacious in most all superficial lesions. However, it is very dangerous when milliampere fluctuations occur. It is very easy to demonstrate that errors in dosage occur during continued line fluctuation. If milliamperage ranges from 4 to 6 in air cooled tube, or from 27 to 32 in water cooled tube, error in the dosage may range from 10 to 30 per cent. These facts make it very imperative that the flow of current be controlled accurately.

We are not always able to determine the type of lesion; therefore, the dosage must be a result of personal judgment. Small lesions do not need as much radiation as large ones; however, it is advisable to give as large a dose as the particular locality will permit.

The rapidity of the growth must be considered when giving a prognosis. If the growth is very rapid, the treatment must be very vigorous in order to depress the proliferative cancer cells. If the lesion is of a long standing, it is not imperative to stop it quickly. The fast growing lesion is more prone to metastasize which makes it more necessary to treat the glands in the surrounding structures to prevent metastasis.

The position of the lesion also controls the amount of dosage that may be given. Where the blood supply is excellent and there is an absence of tendons and bony structures immediately underneath, large doses may be given. Whereas, on the back of the foot and the back of the hand, much caution is necessary to prevent injury to the underlying structures. Lesions about the eye respond very quickly to large doses. We are compelled to exercise caution on account of possible damage to the retina. I have often administered large doses to the eyelids and have never yet seen any impairment of the retina. Large unfiltered doses will always cause a marked conjunctivitis.

Radiation offers excellent advantages because there is a maximum conservation of tissues about the site of the lesion.

Lesions on the lip which are of long standing are practically always potential cancers and should be treated as such. This likewise applies to the tongue and the inside of the oral cavity. It is very important to conserve all the structure possible. I therefore apply only the X-Ray to these lesions; this dose does not destroy any of the underlying structure, and when applied in a large single dose

* This address was inadvertantly omitted from the symposium on treatment of malignant neoplasms which was delivered before Seventh Annual Meeting of the American Congress of Physical Therapy, 1928.

causes the minimum amount of scarring. Treatment of the inside of the mouth is usually done through a short rectal speculum of sufficient size. By this means we are amply able to protect all the surrounding parts.

The pigmented wart, which is distributed over all parts of the body, always presents a serious problem as soon as it shows any malignant degeneration. I usually give about twice the erythema dose over an area of about six inches in diameter; then I cut a mask about the size of the melanotic growth and give it about four times the erythema dose. This administers a lethal effect for about three-fourths of an inch deep. If there is any suspicion that metastasis may occur in any group of glands that drain the affected area, very vigorous treatment is applied to the suspicious zone.

The rapidity of the growth must also be considered when beginning treatment. If the lesion is very slow growing we are permitted to take our time in administering treatment. If the lesion is rapid in its growth it is very evident that curative measures must be administered very quickly. When surrounding tissues are infiltrated it usually presents an impossible task. Prolonged fractional treatments usually have a tendency to irritate any growth of large magnitude. I usually experience that normal tissues will tolerate more X-Ray treatment than neoplastic tissue and for this reason my usual choice is a massive dose.

Another condition which complicates our treatment is that of an inflammatory zone. It is impossible for anyone to estimate the degree of reaction of an inflammatory zone, which makes it almost impossible to estimate the amount of X-Ray dosage which can be given under the above circumstances. Frequently patients present themselves for treatment after they have applied many and countless irritants. Inflammatory areas do not tolerate X-Ray treatment as well as normal skin areas. There is a marked tendency to fibrosis when an inflammatory area is treated by the X-Ray, and malignant structure seems to metastasize through the areas very quickly.

Previous treatment with fractional doses of X-Ray, Radium or Pastes also complicate our efforts to give a proper massive dose. It is generally considered that any previous treatment that has failed, makes our success more difficult.

The physical condition of the patient also has a bearing on the ultimate results. It is the general experience that lesions on very weak and cachectic patients respond quickly to X-Ray treatment; however, these patients usually succumb quickly and add another case to our failures. The more vigorous the patient the slower they are to respond to treatment. Ultimate success, however, is assured in a high per cent of the well nourished cases.

All of our X-Ray treatment is governed by our desired results. No one would dare to burn a patient to a degree of permanent impairment. It is our desire always to remain within limits that are safe. If surrounding or underlying structures are in danger of permanent injury, we must vary our treatment and stay within safe limits. X-Ray burns that follow a single treatment always heal quicker than X-Ray burns caused by fractional doses. Many of our unpleasant results have arisen from the patient becoming frightened and consulting someone who is not familiar with an X-Ray dermatitis. I personally know of an instance of a nurse who was given an erythema dose; she became frightened and consulted her family doctor who immediately applied solutions and ointments of picric acid. The area became inflammed and sloughed and forced her to bed for about three months. X-Ray burns should never be treated with any irritating substance. Cold cream should be freely applied; the lesion should be frequently cleansed and Quartz light treatment may be used in moderate quantity.

In conclusion I wish to state without reservation that my advice to an individual in treating neoplasms is: always use the method that insures success. I have been able to produce a very high per cent of cures by means of X-Ray and have done this with very slight destruction of tissue and with excellent cosmetic results.

EXAMINATION FOR TECHNICIANS BY THE TECHNICIANS BUREAU
American Congress of Physical Therapy
Thursday Evening, Sept. 11, 1930
New Hotel Jefferson — St. Louis

CURRENT NEWS AND COMMENT

Congress of Balneology

The Congress of Balneology, which was held in Bad Elster, April 9-13, concerned itself with three problems of especial interest: (1) Effect of Iron in Mineral Spring Baths; (2) Effects of Mud Baths, and (3) Diet of Patients in Health Resorts.

Research in recent years, carried out by Professor Baudisch, chemist, on the effect of iron in mineral spring baths have stimulated others to investigate the question from the medical point of view. According to the papers presented, iron, the powerful effects of which as a medicament are well known, is especially well utilized by the use of mineral spring baths. These deserve their ancient reputation. It was agreed also that the iron does not lose its efficacy in the waters that are transported elsewhere from the spring, provided the bottling and transportation are carried out hygienically and in a technically correct manner.

Mud baths have been thoroughly investigated from all angles, at the instance of the Zentralstelle für Balneologie, in which research the more recent innovations in physical chemistry were utilized. Their effect lies in the fact that thereby higher temperatures can be applied, the heat thus penetrating deeply into the organs and tissues of the body, so that the reputation of mud baths in rheumatic disorders and in the sequels of inflammations of the internal organs is justified.

The third topic on the program was "The Diet of Patients in Spas, or Health Resorts." Even before the war, a special diet commission appointed by the Balneologische Gesellschaft, under the chairmanship of Prof. Hermann Strauss of Berlin, devoted special attention to the preparation of suitable diets for patients in spas. The investigations of the diet commission now assume the task of establishing on a scientific basis the type of diet that should be followed in the various spas or health resorts. Patients who are gravely ill will, in the future as in the past, be treated in institutions and sanatoriums that are under clinical direction, but the number of patients who do not require sanatorium treatment and yet should follow a suitable diet is large in many resorts, so that also this class must receive consideration by the commission. —(*Jour. A. M. A., 95:62 (July 5), 1930.*)

Regulations Concerning Physical Therapy

To prevent certain unfortunate conditions that have been observed in connection with the use of physical therapy and irradiation by persons who lack technical training, the minister of the interior has assumed the duty of revising the laws that govern physical therapy in offices, institutes and ambulatoriums. The regulations that will be issued require a written statement regarding possession of the radiologic apparatus required for therapeutic purposes and, in addition, describe the precautions that must be used for the safety of the patients and the assistants. Persons wishing to practice physical therapy must show that they possess the special training needed. Special regulations will govern the keeping and storing of radioactive substances and will serve to guarantee the value or capacity of protective devices.—(*Jour. A. M. A., 94:1929 (June 14), 1930.*)

Endothermic Surgery

"I have done a comparatively large number of conservative operations for cancer of the face. I have operated throughout with the diathermic cutting current. The results have been excellent. We have, so far, had no recurrences. I do not, however, say that this method of operating promises such excellent results in all cancers.

I am convinced, from my experience, that, in all malignant tumors, the classic dissection with the scalpel must be condemned. We have, in the diathermic current, a method of operating which dissects even easier than can be attained with cold steel and, as it has the advantage of sealing the blood and lymph vessels as we proceed, we certainly minimize the danger of implanting malignant cells into healthy tissue. These wounds can be sutured,

where sutures are applicable, and for the rest we can leave the external carcinomas to heal by epithelialization.

As the diathermic current absolutely controls capillary hemorrhage, we can survey the operative field with comparative ease. Not in one case I have so operated upon (and they are more than a hundred) have I seen shock or postoperative pain. I once extirpated a cancerous breast, and the patient wanted to go home on the third day; while in another case, in which I ablated the whole external ear and adjacent structures, the elderly and decrepit patient insisted on returning, the next day, to his home. I feel, then, that in all forms of malignant neoplasms, it is a great mistake to resort to classic surgery.

The diathermic surgical current is also exceedingly useful in a number of non-malignant cases. As in everything else, the tendency to overenthusiasm should be checked. Too much is claimed for the advantages of this method of operative surgery.

In urethral caruncle we have, in surgical diathermy, a valuable aid. Many of us have been disappointed, after excising these little growths, to find, months later, that they came back, more annoyingly than ever.

In the past two years I have destroyed these growths in two seconds by coagulation. The first operation was done twenty-two months ago, and the last nine weeks ago. I have seen the older patients regularly, and their caruncles seem to be gone permanently." —(*Mistakes in Everyday Surgery. Gustavus M. Blech. Clinical Medicine and Surgery. 37:587 (August), 1930.*)

In the issue of May 31st of the Journal of the American Medical Association, a report is contained which states that the Council on Physical Therapy has included in its list of recommended devices the following: (1) Comprex Electro-cautery and Diagnostic Light; (2) "Stoppolen" Air Filter. Rejected: West's Gravitiser was considered objectionable because absurd and unwarranted therapeutic claims are made for it and because its superiority over a simple device, such as an ordinary stretcher or table, has not been demonstrated.

It is imperative that expired subscriptions be renewed as promptly as possible. The postal laws require that subscriptions are paid-up in order to retain second class mailing privileges. The expired subscriptions apply to two classes: (1) subscribers who are not fellows of the congress but who subscribe annually to the ARCHIVES; (2) fellows of the congress who receive the ARCHIVES because of their membership in the congress. Fellows who are delinquent in their dues cannot be carried indefinitely. Their subscription to the JOURNAL will cease and their fellowship will lapse. The conditions governing fellowship are stipulated in the constitution and by-laws and must be adhered to.

Subscribers to the official journal who are back in their subscription payments and desire no interruption in the delivery of the Archives are requested to remit at once. Subscriptions will be cancelled after payment is over-due for two months. Fellows are urgently solicited to remit dues by mail without delay. Those who contemplate attendance at the annual session in St. Louis must be paid-up or pay the full registration fee for non-fellows. The secretary will be on hand to receive dues which are in arrears and also 1930-31 dues which are payable from the time of the annual meeting.

Please give these matters your attention and assist our limited clerical force in conducting the affairs of the congress in a business-like manner.

Detroit can boast of being the fountainhead of one international medical society that has enjoyed a successful career. The American Radium Society was organized in this city on the occasion of the last visit of the American Medical Association, in 1916. Dr. Robert E. Loucks, President of the Society in 1922, was one of its pioneers and prime movers in the work of organization. This year the American Radium Society again met in Detroit, June 23 and 24, and Dr. Loucks, as Chairman of the Program Committee, arranged a splendid program on the uses of radium in malignant as well as some non-malignant conditions. — *Wayne County Medical Bulletin.*

The American College of Physicians will hold its Fifteenth Clinical Annual Session at Baltimore, Maryland, March 23-27, inclusive, 1931, according to an announcement received from E. R. Loveland, Executive Secretary, 133-135 S. 36th Street, Philadelphia, Pennsylvania. The purpose of the early announcement of this meeting is to call the attention of secretaries of various societies to the dates, in the hope that their societies will select nonconflicting dates for their 1931 meetings. The Lord Baltimore Hotel will be headquarters. Dr. Sydney R. Miller, of Baltimore, president, will have charge of the selection of the general scientific program. Dr. Maurice C. Pincoffs, of Baltimore, has been appointed by the Board of Regents as the general chairman of the meeting, and will make all local arrangements, including the making up of the program of clinics. Business details will be handled by the Executive Secretary, whose address is at the headquarters of the college, given above.

The twentieth annual clinical congress of the American College of Surgeons will be held in Philadelphia, October 13-17. The plans for this year's congress include attractive programs for a series of five evening meetings, beginning with the presidential meeting on Monday evening at which the president-elect, Dr. C. Jeff Miller of New Orleans, will be inaugurated. The Murphy oration in surgery will be another feature of that evening's session. For the scientific sessions on Tuesday, Wednesday, and Thursday evenings there will be orations and papers by eminent surgeons of the United States and Canada and distinguished visitors from abroad, dealing with various surgical subjects of present-day importance. The annual convocation of the college will be held on Friday evening.

Three hundred members of the American Association of Hospital Social Workers met in Boston for the largest annual meeting ever held. The meeting next year will be in Minneapolis, Minnesota.

The following officers were elected: President, Edith M. Baker, Washington University Dispensary and Allied Hospitals, St. Louis, Missouri; first vice-president, Ruth Emerson, University of Chicago Clinics, Chicago, Illinois; second vice-president, Ruth Wadman, American Red Cross, Washington, D. C.; third vice-president, E. Louise Adams, St. Luke's Hospital, New York, New York; secretary, Edith J. McComb, St. Christopher's Hospital, Philadelphia, Pennsylvania; treasurer, Marie Lurie, Jewish Tuberculosis Service, Chicago, Illinois; executive committee, Mary A. Burke, Montreal General Hospital, Montreal, Canada; and Marguerite Spiers, Berkeley Health Center, Berkeley, California.

Perhaps the outstanding gathering of the meeting was the dinner held in cooperation with the Massachusetts General Hospital in celebration of the twenty-fifth anniversary of the establishment of the Social Service Department in that institution. Dr. Richard Cabot and Mrs. John Glenn were the speakers of the evening.

The Detroit and Cleveland Roentgen Ray Societies met in joint meeting at Toledo on May 22. A paper was presented by Dr. B. R. Kirkland of Rochester, Minnesota, on the subject "Roentgen Manifestations of Giant Cell Tumors." Dr. Otto Glasser of Cleveland read a biographical sketch of Roentgen and Dr. William A. Evans of Detroit presented to the Mayo Clinic a bronze bas-relief of Roentgen. The gift was accepted by Dr. Kirkland on behalf of the Mayo Clinic.

The American Physiotherapy Association conducted its annual session at the Fort Shelby Hotel in Detroit, June 23rd and 24th. The scientific program was given by several of the members of the organization and by invited guests from the medical profession. Among those who presented papers were Dr. Willis Peck of Ann Arbor, Dr. John Stanley Coulter of Chicago, and Dr. Norman E. Titus of New York City.

Physicians and Technicians who will attend the Congress at St. Louis are reminded to obtain RAILROAD CERTIFICATES when purchasing transportation.

THE STUDENT'S LIBRARY

BOOK REVIEWS

RADIUM AND CANCER (CURIETHERAPY). By *Duncan C. L. Fitzwilliams,* C.M.G., M.D., Ch.M., F.R.C.S. Senior Surgeon and Lecturer Clinical Surgery, St. Mary's Hospital; Surgeon, Mount Vernon Cancer Research Hospital, etc. Cloth. Pp. 172—with eight plates (four colored) and sixty-four illustrations. Price $4.50 net. New York: William Wood and Company, 1930.

This volume presents the authors clinical experiences with Curietherapy as utilized by him at St. Mary's Hospital in London. The methods and technics herein employed correspond to those practiced and taught by Professor Regaud and the modern French school. The author points out the greater advantages of the prolonged and intenser dosages, over the smaller dosages, that is now more or less universally employed in every clinic. He states, "my poor results continued until I realized that more radium was needed to do useful work." He came to this conclusion after using the radium after the fashion of his colleagues. He comments: "My results, I frankly state, in operable cases were no better than those of surgery. In some cases perhaps they were worse." It is therefore apparent that the author brings a new message to those who are using radium in their practice.

The first three chapters are devoted to historical, physical and physiological expositions on radium, its emanations and the comparative methods of application. In the main, this section is a handy digest of what is at present known about radium. It is interesting to observe the position which radon is placed by the author and his visualization of abuses in its application. He feels strongly on the matter and expresses himself in a positive manner. He says: "The modern technic calling for the longer and longer time factor in treatment has gradually diminished the uses of radon and now it is mostly used in what is supposed to be hired radium. In establishments which make an income by hiring it out to anyone who requires it, the monetary inducement unfortunately inclines them to allow it to pass into the hands of those who are quite ignorant of radium technic. Commercial institutions are already being formed to exploit this business and it will not be long before it will be placed at the free disposition of the most ignorant, and we shall see a wave of ignominy, disappointment and contempt poured on Curietherapy which such actions will fully deserve. Unfortunately scientific investigation and scientific use of radium may suffer with it." The foregoing is but an example of the positive, and spirited discussions found throughout the book. There is, however, a danger in its overenthusiasm. It leads to unconscious exaggeration of facts. Certain positions of this treatise are frequently found colored to the eye-to-eye point of view of the writer. One can point out such an example in the discussion of Oral Carcinoma. In just a single sentence he sweeps aside all of the recent contributions to surgical diathermy and the knife. No mention is made of the advantages of the new types of electrothermic cutting current. Neither does he mention one objection to the method. He dogmatically makes the following statement: "The use of the knife or of diathermy is advocated by some, but I cannot recommend either, especially the latter."

It should be the objective of all who are interested in the relief of malignant growths to combine or to point out methods that will be most conducive to the relief of the patient. There is now a tendency in America to combine both measures (diathermy followed by radium) in all accessible growths. The eradication of the tumor followed by radium implantation appears to be more logical than mere implants. The author himself points out that many of these smaller growths within the oral cavity are much deeper than the outward appearance. Thus, the radical destruction of the growth by surgical diathermy should be the logical forerunner of radium treatment. This book is, nevertheless, a timely contribution to the subject. It discusses most all conditions where radium is indicated. Gynecologic affections are authoritatively discussed by Donaldson, one of the outstanding investigators of radium in England. A great part of this chapter is devoted to the important topic of technic and an evaluation of method.

This volume has been written for the general clinician who will readily comprehend the general discussion. It is free from technical expositions and from mathematical formulas. It is richly illustrated and calls attention to newer methods and concepts in radium therapy.

DISEASES OF THE NOSE, THROAT AND EAR. MEDICAL AND SURGICAL. By *William Lincoln Ballenger,* M.D., F.A.C.S., Late Professor of Otology, Rhinology and Laryngology, College of Medicine, University of Illinois, Chicago; etc. Revised by Howard Charles Ballenger, M.D., F.A.C.S., Associate of the Otho S. A. Sprague Memorial Institute Laboratory of the Children's Memorial Hospital, Chicago; Attending Otolaryngologist to the Evanston Hospital, Evanston, etc. Sixth Edition, thoroughly revised. Illustrated with 583 engravings and 29 plates. Lea and Febiger. Philadelphia, 1930.

In the main this text follows the plan of the original first edition, although the revisions have added much that is new and excluded information that is now considered obsolete. The revising author

states with reference to this sixth edition: "The opportunity afforded by a new revision of this work has been utilized for a rearrangement and a partial rewriting of various portions, particularly the chapters devoted to the Sinuses, Suppurative Otitis Media and Mastoiditis."

In the descriptions of the various surgical procedures there have been only minor changes. Some of the more recent surgical measures have been incorporated. A noteworthy addition to the section on the Larynx are the chapters on Bronchoscopy which has been written by Jackson and Tucker. Dr. Tucker's contribution deals with The Bronchoscopic Clinic, Direct Laryngoscopy and Tracheobronchoscopy. Dr. Jackson's writing is on Esophagoscopy with Gastroscopy. The editor believes, and correctly so, that the value of this new edition is greatly enhanced by these authoritative presentations.

The book is divided into five parts. Part one deals with the ear; part two, the nose and accessory sinuses; part three, the pharynx and fauces; part four, diseases of the larynx; and part five, bronchoscopy. As a text this division of subjects is ideal both for the student and the practitioner. It is true that there have been published any number of modern books on otorhinolaryngology since Ballenger's work, but it is doubtful whether there has been one which is more complete, authoritative and instructive. From the very fundamentals each subject is developed in a coherent style and the revisions have adhered to this plan, much to the favor of the original work and its successive editions.

A regrettable fact is the commission of a few errors in the spelling of names of authors who are quoted. This is of little consequence, however, and no doubt will be corrected in the next edition. A further criticism is the quotation of remedies and methods which, although advocated, have been found by experience to be lacking in value pronounced by the original claims. The inclusion of these remedial measures in the text material lead the readers to assume full authenticity of claims, while the results of extensive clinical trials have established many of the positive assertions to be based on overenthusiasm of results in small series of cases.

In view of the large amount of work which has been done with physical agents in diseases of the ear, nose and throat, more references to physical therapy appear warranted. The subject of electrosurgery of tonsils should receive some special consideration, especially so since there is so much indecision with reference to the method.

References to diathermy are not altogether accurate, and although medical diathermy is vaguely defined, emphasis is made chiefly on the value of surgical diathermy for new growths. Some brief references are made of the use of radium and x-ray for malignant growths, but in the main, these descriptions are limited.

As a whole, regardless of these omissions and criticisms, the work is a living monument to Ballenger who pioneered the specialty of otorhinolaryngology and contributed much toward its advancement. It is hoped that in the next revision more attention will be paid to the newer advancements in therapy, especially with reference to light, heat and electricity, the therapeutic value of which have been definitely established for a variety of pathologic indications.

CLINICAL ELECTROCARDIOGRAMS (Their Interpretation and Significance). By *Frederick A. Willus,* B.S., M.D.S. in Medicine, Section on Cardiology. The Mayo Clinic, Rochester, Minn., Associate Professor of Medicine, The Mayo Foundation University of Minnesota. Pp. 219, with 368 illustrations. Cloth $8.00 net. Philadelphia: W. B. Saunders Co., 1929.

The author informs the reader in his preface that he "has attempted to present clinical electrocardiography in a graphic manner and he hopes that the illustrative examples may aid those whose experience in this field is limited. The attempt has been made not only to present typical records of cardiac disorders but also to present records which exhibit transitional changes."

The entire volume is richly illustrated with pertinent cases gathered from a large field of material which have been selected from the Mayo Clinic. The intention of this volume is to bridge that necessary link for the beginner who has mastered the theories and technic, and acquainted himself with the principles of electrocardiography, but who desires broader opportunities in interpretation of printed records.

The wealth of material included within these pages can therefore be utilized by the student to more thoroughly orient himself with this new and intriguing specialty. A rich bibliography is included to the end of each chapter which gives the reader opportunity for a broader acquaintance with any phase of the subject that he is interested in.

This volume therefore offers a broader educational opportunity for those interested in the interpretation of clinical electrocardiograms. The author has purposely omitted any controversial discussions. This work fills a needed place and will be especially appreciated by the cardiologist. It is recommended to the readers as a valuable book on the subject.

ELEKTROTHERAPIE, EIN LEHRBUCH. By *Josef Kowarshik,* Primarzt und Vorstand Des Institutes Fur Physikalische Therapie im Krankenhaus Der Stadt Wien. Pp. 312, Third enlarged edition with 269 illustrations and 5 charts. Price $5.65. Berlin: Julius Springer, 1929.

A successful attempt has been made by the author to re-edit the entire text of the present edition. He has included only such material which has stood the test of critical investigation or personal experience. The volume deals in great detail with the entire range of electrotherapeutic instruments and discusses the physical and physiologic principles, theories, and practical usefulness of all the accepted agencies. The author is justly reputed to be one of the outstanding pioneers on the continent. He therefore brings to this edition not only a rich experience based upon many years of practice and teaching, but also that invaluable experience that comes to one only with mature orientation.

The book is divided into four parts. Part one deals with the fundamental nature of the physical

energies which enter into the discipline of electrotherapy. The reader is initiated into this by way of an exposition of the modern theories of the electron, its dimensions, its energy content and a schematic picturization of the atom, according to the conceptions of Bohr and Sommerfield. There follows, then, a short exposition on electric currents with the classical examples, illustrations and definitions of all the associated mathematical formulas. This part is strictly technical. Part two discusses electrotherapy technic, the interpretation of direct and alternating and high-frequency currents and the indication of their medical application. This section is clearly one of the finest expositions on this phase of electrotherapy as is to be found in any modern text book on the subject. The information is compact and concentrated and speaks highly for the author's industry. The author has here included a concise discussion of the principles and technics of galvanism, faradism, static eletcricity, low frequency and high frequency alternating currents, and a differentiation between currents of relatively low frequency and high tension, called d'Arsonvalization, and those of high frequency and relatively low tension, called Diathermy.

Part three deals with the basic physiologic effects as produced by electrotherapy. This discussion is divided into five chapters and considers the conductivity of the human body to electric currents; an evaluation of the various resistances of living tissue; the physico-chemical effects; the physiologic effect of electrical currents in health and in disease. This section is very meaty and suggestive.

The last portion of this volume devotes itself to the clinical interpretation of the value of all of the foregoing agencies. The discussion includes the management of cases, the indication and selection of the proper electrotherapeutic measure for typical pathologic states, evaluation of the methods utilized and the limitation of these measures. The galvanic current is the first to be considered. The various methods of applying this current are pointed out. Attention is directed to the outstanding qualities of stabile and labile galvanization, the effect of the interrupted current which includes an interpretation of the much discussed LeDuc current and its differentiation from the galvanic. Some very interesting suggestions are also included in the discussion on iontophoresis and medical electrolysis. Faradism receives valuable consideration. There is much of value in this current that has been neglected by American practitioners due to the greater interest at present in Diathermy and high frequency therapy. The latter agency is discussed in great detail. The author has emphasized many of its effects and has called attention to its therapeutic properties in great detail. The entire section has been developed in a clear and comprehensive manner. Herein emphasis is placed on the practical value of electrotherapy, and is exemplified by clinical indications and examples. The reviewer feels that this volume is one of the foremost contributions to physical therapy. It should be in the hands of all those actively interested in its specialty. It is regretted that it has not thus far been translated into the English language. The book is highly recommended.

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INTERNATIONAL ABSTRACTS

Einfluss Der Rueckenmarksdurchwaermungen Auf Die Hyper—Und Dysidrosis Manuum. (Influence of heating of the spinal cord on hyper and dysidrosis of the hands). Roman von Leszczynski.

Dermatol. Woch., 1929, Bd. 89, Nr. 41, (Sept.) p. 1473-1480.

It is a well-known fact that the function of the sudoriparous glands is dependent on the sympathetic nerves. Spinal sweat centres are situated in the anterior horn, not far from the motor cells. Thence the sweat fibres run through the *rami communicantes albi* to the intervertebral ganglia, join the spinal nerves and, in conjunction with them, reach the periphery and sweat glands. This being the case, the author has tried to influence hyper and dysidrosis by diathermizing the spinal cord. Diathermy prevails over x-rays by its complete safety and ease of administration. The technic applied was as follows. The active electrode, the size of 6 by 8 cm., is placed on the spinal column between the sixth cervical and second dorsal; the passive one, the size of 9 by 14 cm., on the sternum beneath the interclavicular notch. Exposure time 20 minutes with an amperage of from 500 to 700 milliamperes, daily sittings. In 32 cases the results were favorable, though not lasting; the periods of improvement, however, last much longer than when atropin treatment is given. Spinal cord heating affords particular advantages in such cases of hyper and dysidrosis as are complicated by inflammatory manifestations.

Was Sollen Wir Galvanisieren Und Was Faradisieren? (What should be galvanized and what faradized?) Eugen von Thurzo.

Fortschr. d. Ther., 1929, Jg. 5, S. 581-584.

Direct current is above all used in nervous paralysis, neuralgias and local spasms. Fresh peripheral palsies require cautious administration. Only in the first week should the paralyzed muscles be electrized; in the second, gentle anodic galvanization with a labile irritating electrode; only in the third week should cathodic galvanization be begun. If there is secondary contraction, galvanization and faradization must be abandoned. In the presence of arteriosclerosis and Parkinson's disease, neither galvanic nor faradic electrization should be performed. Anodic galvanization is recommended in tinnitus of the ears, Grave's disease (goiter galvanization), and irritation due to swallowing (phrenic nerve). Faradization is urged in palsy of the peripheral nerves with preserved irritability, in myasthenia, general exhaustion, hysterical aphonia, and sexual weakness (prostate). There is a contraindication to faradization in neuralgias, spastic palsies and hemiplegia.

Die Roentgenbehandlung Oberflaechlicher Entzuendungen. (Roentgen ray treatment of superficial inflammations). Ernst Otto.

Dtsche. med. Woch., 1929, Jg. 55, Nr. 47, (Nov.) p. 1968-1969.

Roentgen therapy is of value in abscesses of the sweat glands, localized furunculoses, as well as in recurrent hordeolum. In phlegmonous inflammations, any attempt at influencing the morbid process favorably is justified. The radiation used in treatment of carbuncles is of medium hardness, filtered by 3 mm. Al.350 R were given, although, under proper protection, to the immediate surroundings of the carbuncle. For abscesses of the sweat glands, the dosage was the same as for irradiation of carbuncles. The author administered the dose by two halves at intervals of four days. Recurrent styes could be cured by three irradiations (without filtration, 75 R each time, at intervals of eight days). It should be noted that irradiation of carbuncles frequently produces a violent exacerbation of pain of about 3 to 5 hours' duration, which is then followed by conspicuous relief. Something similar is also seen in case of abscesses of sweat glands. There is however no immediate retrogression after the reaction has cleared up. One must, on the contrary, expect the inflammation to increase. Fresh foci frequently develop which occasionally may even require an incision. But here, also, one is impressed by the ready transition from suppuration to thin, serous exudation, and the quick draining of secretion.

Die Roentgenbehandlung Der Prostata Be Retentio Urinae. (Roentgen ray irradiation of the prostate in urine retention). Viktor Schiller and Walter Altschul.

Strahlenther., 1930, Bd. 36, H. 1, (March) p. 179-182.

According to the experiences of the authors, radiotherapy combined with the routine conservative treatment, doubtlessly yields remarkable results in old prostatics, also in the second stage (retention of urine) despite most severe morbid manifestations. In two-thirds of the cases micturition could again be restored to such a degree that it was no longer necessary to catheterize these patients, and this result persisted. On the basis of their experiences the authors recommended as a matter of principle to extend the indication to roentgen ray treatment for prostate hypertrophy, also to cases of the second stage. The presence or the suspicion of a tumor of the prostate is about the only contraindication to x-radiation. Early operation is here indicated.

Nutzen Und Schaden Der Lichtbehandlung. (Advantages and drawbacks of light-treatment). Hans Günther.

Med. Welt, 1930, Jg. 4, Nr. 11, (March) p. 359-362.

The effect of light treatment with natural or artificial sources can be explained on the basis of non-specific irritation therapy. From this also roughly follows the indications of light treatment. In contradistinction, however, to the parenteral, medicinal protein therapy, local application spreads over a much larger surface and the effect of each dose lasts longer. Light treatment is only useful in certain diseases, and inefficient or harmful in others. In metabolic affections it can as a rule be dispensed with. Tetany and spasmophilia are favorably influenced by irradiation, frequently after a transient increase of the tetanic symptoms. In chronic arthritis the usefulness of light treatment is nearly the same as in the other non-specific irritation procedures. In chronic, non tuberculous affections of the lungs, light therapy thus far has yielded no success. In tuberculosis, light treatment is only a special form of the non-specific irritation therapy; therefore, also, the same indications and contra-indications are to be observed. The results obtained in tuberculosis of the skin, bones, joints, peritoneum and genito-urinary tract are on the whole generally good. The field of pulmonary tuberculosis is still, however, very controversial. French authors are generally very optimistic. In Switzerland, whose natural alpine sun is generally praised in the treatment of "surgical" tuberculosis, the application of direct sun baths is resorted to, though in a very cautious manner (protection of head and breast). The author is of the opinion that, in tuberculosis, the general condition is often improved by light treatment, whereas a curative effect on the malady proper cannot be assumed. Light treatment, given without dosage and control, may very easily produce a pulmonary tubercular lesion. Especially is this possible when too strong a dosage is enforced, or it may produce a further diffusion of the pulmonary process. The degree of acquired pigmentation is irrelevant to the prognosis of pulmonary tuberculosis.

Untersuchungen Ueber Die Wirkung Von Diathermie. (Inquiries into the effect of diathermy). E. A. Spiegel.

Ztschr. f. d. ges. Neurol. u. Psych., 1929, Bd. 122, p. 475-498.

Local passage of high frequency currents through spastic muscles exerts a frank decrease in their tonicity as shown by the improvement of active motility. Spiegel attributes this effect of diathermy to the dehydration influence on muscle proteins. In the tremor forms, investigated by the author in regard to their behavior to high frequency currents, a distinct increase of tremor proved to occur in Parkinson's disease. Most of the remaining tremor forms (functional, toxic tremor) showed no sensible change under the influence of local diathermy.

Ueber Die Beziehungen Anaphylaktischer Und Anaphylaktoider Zustaende, Insbesondere Des Peptonshocks, Zu Den Reaktiven Vorgaengen Der Thermalbaeder. (On the relations of anaphylactic and anaphylactoid conditions, especially of the peptonic shocks, to the reactive processes of thermal baths). Grunow.

Zeitschr. f. d. ges. physikal. Ther., 1930, Bd. 38, H. 3, (Jan.), p. 90-102.

Cases of thermal bath shocks occur in women with abdominal disturbances. They were especially encountered in patients with myomatosis of the uterus. This thermal bath shock shows a certain similarity to anaphylactic conditions (peptonic shock, anaphylactic shock). The manifestations can be explained by increased sensitivity of the vegetative nervous system and the irritative effect of thermal baths on the same. At the onset of the thermal bath treatment there develops a predominant vagotonia of the skin, characterized by the increase of the local blood circulation and stimulation of the sweat glands. In the reactive course of the cure for morbid local processes, the system of the skin vessels and the metabolism have a marked tendency towards evolving within the compass of the biological processes of the peptonic shock. The similarity of the latter to the anaphylactoid shock of women with abdominal affections involves the analogous finding of a fall in leucocytes, erythrocytosis in hematological respect, and a cation combination in the blood in the direction of a decrease in number of the calcium ions, and a relative overbalance of the potassium ions. The fall in leucocytes shows time relation to the local reaction, and has a bearing on the vegetative nervous system. It is due to increased vagotonia of the skin and enhanced hypersensitivity of the capillary synapses. It is particularly the latter effect which gives it the stamp of an allergic symptom complex.

Roentgenbestrahlung Bei Asthma Bronchiale. (Roentgen ray irradiation in bronchial asthma). Viktor Zipperlen.

Strahlenther., 1930, Bd. 36, H. 1, (March), p 88-93.

The author recommends submitting patients with bronchial asthma—apart from the routine methods—to roentgen ray irradiation. In the irradiation treatment he likes best the small field method, i. e., he uses a distant field in front without protecting the heart, four small fields from behind and he furthermore irradiates the spleen in front (⅓ SUD each, 32 cm. focal skin distance, filtration by 0,5 Cu plus 4,0 Al). The opinions of the authors differ widely as to the mode of action of this procedure. Some consider the curative effect to be chiefly suggestive, some assume the cells of the mucous glands in the lungs to be injured, whereby the secretion of mucus is lessened. Zipperlen himself thinks the opinion of Gottschalk plausible, that enlarged ganglious packets at the hilum enforce asthmatic fits by pressure on the vagus and are then reduced in size by the action of the roentgen rays. There is, however, general consensus of all authors as to the success of radiotherapy in bronchial asthma.

Die Bedeutung Der Radium—Emanation In Der Baederwirkung. (The importance of radon in bath action). S. Lachmann.

Med. Welt, 1930, Jg. 4, Nr. 15, (April), p. 518-519.

The quantity of radon passing through the skin has been proved to be only an extremely small fraction of the amount applied. One would be mistaken in concluding from this that the use of radioactive waters in the form of baths is inefficient, for even the smallest amounts of radium emanation getting into the system or even only adhering to the skin, represent a source of radiation. It is thus in a position to continually produce new energies. There is no doubt, however, that absorption by respiration or by drinking of mineral water plays an important part exclusive of the action of the bath. For this reason the introduction into therapy of radon by oral and inspiratory administration, besides its employment in the form of baths, may be considered as a rational method. Since combinations of radon with other elements are unknown, there remains no other explanation for its efficiency in the system than the assumption of an action of the various radiations. Radon, itself, emits only *alpha* and *gamma* rays, endowed with strong penetration power. According to Dessauer these rays bring about the ionization of the tissues struck by them and represent an ample source of energy, exchange and recombination. Thereby a very high, but strictly circumscribed energy is set free at the several points within the cells, which process must, of necessity, act as a strong intracellular stimulus.

The use of high radioactive waters is advisable in chronic inflammatory diseases. From this point of view it is easily understood that good results are reported in various forms of articular rheumatism and chronic inflammations of the female sexual organs, as well as in neuritides. Further indications are gout, the stabbing pains of tabetics, hypertonia and slight forms of arteriosclerosis. Among the diseases of the skin, sclerodermia seems to respond well to radon.

Die Entwicklung Der Physikalischen Therapie In Wissenschaft Und Praxis. (The development of physiotherapy in science and practice). Ernst Tobias.

Ztschr. f. ärztl. Fortbildg., 1929, Jg. 26, Nr. 20, (Oct.) p. 661-666.

The aim of various forms of massage is to relieve myalgic pain, to relax the spasms and to prevent muscular retrogression. Lange's gelotripsy acts by softening muscular indurations and by pushing the disintegrated products into the circulation. Mueller's massage is a milder method; it represents a selective effleurage of muscles afflicted with hypertonus. Ruhmann's palpation massage is a manual procedure based on training of the tactile sense. Ruhmann suggests preceding it by red light irradiation.

Electrotherapeutic measures are advocated by the author who especially emphasizes the value of high frequency currents. Attention is directed to the treatment with high frequency and low voltage currents, that is with diathermy, and to treatment by high frequency and high voltage currents, that is Arsonvalisation. Diathermy treatments should never be given beyond the point of comfort to the patient and the treatment should be varied according to the clinical result. In neuralgias and in the lancinating pains of tabetics, it is advisable to have diathermy followed by mild blue light irradiation. It is thus possible to abolish untoward reaction or to reduce it to a minimum without lessening the action. Diathermy is a good indication in myalgias and chronic diseases of the joints. Among the affections of the nervous system diathermy acts better in neuritis than in neuralgias. General diathermy (one electrode being applied to the upper region of the back, one each at the soles) produces strongly sedative effects in general nervous hyperexcitability with or without hypertonia. Diathermy acts favorably on cardiac neurosis, mild cases of angina pectoris, intermittent limp, frostbite, bronchial asthma, dry pleuritis of the non-tubercular type, duodenal ulcer and spastic constipation. For cholecystitis the author prefers mud compresses to diathermy. Diathermy is further advisable in glomerulonephritis. In some cases, the author observed ureteral calculi passage after a few sittings.

For general Arsonvalisation, autoconduction in the solenoid cage is employed for mild cases of nervous insomnia, presclerosis and for the purpose of decreasing the high blood pressure in cases of essential hypertonia. For local Arsonvalisation, a series of smaller equipments (radiolux, mediotherm, etc.) have been recommended besides the large one. Unfortunately, the laity have in their ignorance observed the use of these small apparatus. Laqueur recommends the latter in older neuralgias of superficial (not hyperesthetic) nerves when associated with a certain hypalgesia of the skin and for the relief of itching in pruritus and anal fissure.

In discussion of light treatment, blue and red light irradiation is particularly emphasized. The former is used in neuralgias of superficial nerves, in rheumatic muscular pain. Red light is of value in diseases of the skin associated with inflammation, and pain and itching as found in dry and exudative pleuritides. Both kinds of irradiation are best used during the intervals.

Carbon-Monoxide Poisoning — Uv.-Therapy. Fr. Coza.

Med. Klinik, No. 12, 1930.

The author has been able, in his laboratory, by animal experiments and also by clinical tests, to demonstrate that strikingly favourable results can be achieved in cases of severe carbon-monoxide poisoning by intensive treatment with ultraviolet rays (total exposure at a distance of 60 cm., each side of the body for 20 minutes whilst producing hyperaemia of the skin by friction in addition to the usual liberal O_2 inhalation). The ultraviolet rays delay the combination of carbon-monoxide and haemoglobin and accelerate the dissocation of the combination of carbon monoxide and haemoglobin that has already taken place.—*(Ars Medici, 8:252 (June) 1930.)*

Neueres Ueber Rachitis Und Deren Behandlung. (Recent acquisitions concerning rickets and their treatment). E. Wieland.

Fortschr. d. Ther., 1930, Jg., 6, Nr. 5, (March), p. 134-142.

Distinction should be made between direct and indirect light therapy. In both cases treatment ought to be performed regularly—daily, if possible; it should average from 4 to 8, at longest 10 weeks. Treatment should set in as soon as rickets is diagnosed, severer forms thus being obviated. Since rickets is a pronounced infantile disease, it is therefore useless to irradiate children of preschool age or school children.

Direct light therapy can be given by quartz light rays or by way of sun light. Rickety patients are to be exposed naked to the quartz lamp rays at 1 meter distance for from 10 to 12 minutes. It is sufficient to give irradiations at least three times a week. Irradiation by sun light offers certain difficulties. At midsummer time and midday sun light is no doubt rich in ultraviolet rays, in winter the duration and intensity of sunshine are for the most part insufficient in some countries. In addition it ought not to be overlooked that reckless solar treatment in midsummer and during midday heat may be absolutely harmful to many children; it is not the senative ultraviolet rays but the heating rays which are to be feared. In order to protect oneself against the last mentioned rays in summer and against cold in winter, it is convenient to have the sun cure of the rachitics performed in the room behind closed windows. These windows ought not, however, to consist of ordinary window glass as it is impermeable to ultraviolet rays of 300 millimicrons wave length. The windows ought, therefore, to be made of quartz or a similar substance, permeable to ultraviolet rays. The so-called ultra-glass or ultravit-glass is fitted for this purpose.

Indirect light therapy consists in drinking irradiated fresh and dried milk or eating irradiated vegetables or irradiated egg yolk, besides in taking daily 1 or 2 tabloids of irradiated ergosterol for from 4 to 8 weeks.

Ueber Malariarheumatismus. (On malaria rheumatism). Ladislaus Lichtenstein.

Ztschr. f. wissenschaftl. Bäderkunde, 1929, Jg. 4, H. 2, (Nov.) p. 196-198.

According to the author's observations all the types of malaria can be complicated by febrile polyarthritis, both during the febrile stage and in convalescence. Although plasmodia have never been found in the tapped articular effusion, it is nevertheless probable in the author's opinion that this arthritis is at least due to malaria toxins. In this polyarthritis the fact was most noteworthy that quinine and salicyl preparations which for the most part had been given combined, had been of no obvious help. Only forced thermal cures led to improvement; also, the more or less severe lesions of the joints showed improvement under the thermal therapy (mud baths and mud packs).

The Gall Bladder In X-Ray. F. Brockmann and V. Schenck.

Deutsche medizinische Wochenschrift No. 33, 1929.

Intravenous injection of Jodtetragnost is now being used to depict the gall-bladder on the screen (Ars Medici 1927). In a few cases, however, injury from this procedure has been reported, for example collapse and inflammatory thrombosis of the arm veins, a complication that one does not like to meet in a purely diagnostic procedure. There have, therefore, been attempts since its introduction to administer the iodine orally. Capsules were tried but without success, since the absorption depends on varying conditions in the intestinal tract. If the capsules dissolve in the stomach there is malaise and vomiting, if on the other hand they dissolve too late in the intestines their effect is minimal. *Kirklin* and later *Standström* found a new method: by the addition of acid they changed the sodium tetraiodinephenolphthaleine to the easily tolerated anhydride, which is again reconverted to the original substance in the alkaline intestinal tract. The Firma Merck in Darmstadt has prepared Oral-Tetragnost with fruit acids and has put it on the market. The preparation is simply taken with water, it must be thoroughly dissolved, otherwise vomiting may occur. In the right concentration it is well tolerated. Three pictures are then taken, about 10, 12 and 14 hours after administration. The authors report very good results with the new preparation. The plates are serviceable, though not quite as clearly defined as with intravenous injection of Jodtetragnost. It is advisable to try oral administration always, and only in such cases as prove unsatisfactory should intravenous injection be resorted to.—*(Ars Medici, 8:109 (March) 1930.)*

Menstruation and Physical Exercise. E Dünter.

Zentralblatt für Gynaekologie, No. 1, 1930.

The writer has made observations on 110 girls and women in order to find out whether the continuation of gymnastics and sport during menstruation has a favourable or an unfavourable effect. Individual cases in which the effect was unfavorable are counterbalanced by a larger number in which the effect was favourable. In general, we may say that healthy women and girls who are accustomed to physical exercise may, if they wish, continue gymnastics and sport (with the exception of swimming and of actual endurance tests), even during menstruation, with impunity provided that the demand made on the body during those days does not appreciably exceed the measure of their daily achievements. Unpleasant results were only observed with exercises of the abdominal muscles such as all free exercises which make special demands on the muscles of the abdominal wall, particularly some exercises on the floor and the so-called bridge; the same applies to all exercises with gymnastic apparatus that involve great exertion of the abdominal muscles such as almost all exercises on the horizontal bar, and many exercises on the rings and hanging apparatus, sometimes also jumping. No troubles ever seem to result from the so-called pelvic exercises such as Mensendieck's swaying of the pelvis.—*(Ars Medici, 8:219-220 (May) 1930.)*

Zur Frage Der Kuenstlichen Hyperthermie Auf Physikalischem Wege. (Contribution to the question of artificial hyperthermia by the physical route). Adolp Weissmann.

Ztschr. f. d. ges. physik. Ther., 1930, Bd. 38, H. 4, (Febr.), p. 103-110.

Walinski of Goldscheider's clinic has suggested a method of producing artificial hyperthermia by the physical route. This method is intended to produce high temperatures similarly to the arbitrarily provoked infection by malaria, recurrent fever, tuberculosis, etc., and thus to effect improvement in general paralysis, syphilis of the brain, tabes dorsalis, and disseminated sclerosis. The patients received a full bath of from 36 to 37 degrees C. and were then packed in one flannel and six woolen blankets. Five minutes before the bath they are injected intravenously with 10 c.c. of a 25 per cent sodium chloride solution, in order to inhibit secretion of sweat. The patients are kept for 20 hours wrapped up in these blankets under suppressed secretion of sweat and reach temperatures up to 42 degrees C. The author has checked off this method and come to the conclusion, on the basis of his experiments and analysis that the acquired temperatures are exclusively due to the bath and consecutive pack. He sees the only cause of this artificially produced hyperthermia in the discrepancy in the dysfunction of the thermoregulatory factors, that is to say, in the prevention of loss of heat by convection and radiation, owing to the great number of air layers (seven coverlets) and in the relatively slight secretion of sweat as compared with the strong heat stasis owing to the hinderance of evaporation. The author believes that the addition of intravenous sodium chloride doses is not indispensable. The temperatures attainable by packing reach for the most part a therapeutic desirable height. Hyperthermia can be maintained for any length of time so that the requirements of hyperthermia treatment can be met with. This method makes, of course, a great many demands on the biologic performance on the part of the system, but is tolerated well and without any sequels by most of the patients. The bath should last half an hour. Thus far, the therapeutic experiences of the author cover *malum coxae senile*, primary chronic polyarthritis, arthritis deformans, osteoarthritis, rheumatic ischialgia, Perthes' disease, disseminated sclerosis and tabes dorsalis; improvement of condition could be obtained in subjective and clinical respects. The author will discuss the contraindications in a later paper.

Beziehungen Zwischen Chirurgie, Balneologie Und Klimatologie. (Relations between surgery, balneology and climatology). J. Weber.

Schweiz. med. Woch., 1930, Jg. 60, Nr. 15, (Apr.) p. 339-341.

A particularly interesting domain for team-work between surgeons and balneologists is that of the diseases of the biliary passages. Surgeons are correct in postulating early operation; the practitioner, however, knows how difficult it is to persuade a patient to submit to extirpation of the gall-bladder. One has mostly to deal with patients who have undergone numerous biliary colics in the course of many years. An affection of many years' duration is, however, after all, a challenge to surgical treatment, in consideration of the possibility of perilous complications. Here it is where balneology is successful in the management of the patient by its baths, drinking cures and fango packs. Possible infectious complications can be reduced by these measures and operation on the bile passages can thereafter be performed with greater safety. There is the same indication to balneological therapy after the operation.

Quite the same advantages hold for the treatment of concretions in the urinary tract.

The cooperation of balneology and gynecology is of utmost importance. The principal indication for bath treatment are para and perimetritis, oophoritis and salpingitis. Unfortunately, the error is frequently committed of submitting the patients to bath treatments too early. The latter is only indicated when the inflammatory disease has passed into the chronic stage, which event happens for the most part after three months or so following the last rise in temperature. An important hint is given by the Fahracus reaction. Experience tells us that the bathing cure can only be begun after the Fahracus reaction has become normal.

L'Electrotherapie Dans Les Affections De L'Appareil Digestif Et De Ses Annexes. (Electrotherapy in Affections of the Digestive Tube and Its Appendages). Jean Hollenfeltz.

Bruxelles Med., 1929, ann. 9, Nr. 28 (May), P. 797-804.

In electrotherapy the currents utilized are the galvanic, faradic, the galvano-faradic of Wattsville, the sinusoidal and high frequency currents. For the first four kinds of currents a single treatment with an amperage of from 20 to 50 MA will most often suffice. For diathermy the author uses tin foils one mm. thick, cut in every individual case into appropriate form. Amperage has to be adapted to the mode of treatment and to the size of electrode. The current or amperage should be raised slowly from 0— to maximum in about five minutes. Treatment time, 20-30 minutes.

Electrotherapy is used in motor and neuromotor disorders such as spasms of oesophagus, cardia, pylorus and bowels, and crises of the solar plexus. The anodyne effect of the galvanic or sinusoidal current is far inferior to that of diathermy, whose results are permanent. Diathermy is of advantage also in treatment of gastric atony, constipation, and in postoperative gastrointestinal paresis, especially when the rhythmical Watteville current gradually raised to 30-40 ma. is used simultaneously.

Diathermy is also beneficial in affections of inflammatory and infectious conditions, such as enteritis, enterocolitis, colitis, subacute and chronic appendicitis, inflammatory diseases of the biliary tract, peritoneal adhesions which are loosened, in aerocolia and inflammatory and cicatricial strictures of the rectum.

Ueber Den Einfluss Von Moorbaedern Auf Das Weisse Und Rote Blutbild Bei Rheumatikern. (On the influence of mud baths on the red and white count in rheumatics). Rudolph Jurgens.

Dtsche. med. Woch. 1929, Ann. 55, Nr. 28 (July) p. 1172-1174.

Examinations of rheumatics after mud bath treatment show a high rise in the leucocytic count with *neutrophilia* and deviation to the left after the first few baths. These blood reactions occur after each single mud bath. The maximum effect is observed at the height of the outbreak of sweat, soon after the bath. At the end of a few hours the fall begins. During the mud bath treatment these phenomena appear strongest in the so-called bath reaction; they recede after 18 or 20 mud baths. They are replaced by high lymphocyte counts. After longer action of mud baths the number of the vitally granulated red blood corpuscles of the peripheral blood rises from the normal (3-4 in 1000) to from 25 to 30 in 1000, together with the general reaction of the body. At the same time there is a deviation of the red blood count to the left. The rise of the leucocytic count and deviation to the left of the white blood corpuscles occur after each bath, while the number of the vitally granulated red blood corpuscles rises gradually and persist 'till the close of the treatment.

A New Visualizing Bladder Neck Punch with High Frequency Coagulation Electrode Attachment. Robert V. Day, M. D.

J. A. M. A. Vol. 94, No. 21, May 24, 1930.

Since Guthrie in 1828 first accurately described its clinical and pathologic manifestations and ten years later Mercier devised such ingenious instruments for its cure (which no doubt would have survived had there been reliable means of accurate diagnosis such as the cystoscope), many procedures have been tried and many instruments devised by clinicians scattered over Europe and America for the relief of obstruction due to contracture of the bladder neck, often called median bar. Each has added something of value to the solution of the problem.

Fundamentally Young's punch procedure seems the method that most nearly attains the objective. The addition, by McCarthy, of accessories and refinements make for maximum efficiency with easy workability and delicate control. Superb vision through a foroblique telescope coupled with the last word in construction, workmanship and improved materials, together with the ease by which the bleeding is subsequently controlled by means of a d'Arsonval current through a McCarthy stiff stem electrode, have made this operation precise and efficient with an infinitely easier, smoother and more rapid convalescence, attended by a minimum of danger, provided it is done by a trained, experienced and skillful urologist. With this instrument every advantage of the McCarthy punch is retained with the added insulated needle for preliminary electrodesiccation with a d'Arsonval current. In this type, however, the biting blade cuts from within out; that is to say, the bite starts from the bladder aspect instead of the urethra as in the McCarthy instrument. It removes slightly larger bites of tissue. The time saved is considerable because the preliminary electrodesiccation obviates the necessity of high frequency cauterization in the presence of active bleeding as is the case when the McCarthy punch is used. Even with my punch it sometimes may be necessary to follow up with a bit of high frequency cauterization unless one has continued the preliminary desiccation to such a degree as to run the risk of devitalizing the tissues to an unnecessary depth. The ideal objective is a maximum of hemostasis with a minimum of tissue trauma by the high frequency current.

Electrocardiography in the Clinical Study of Heart Disease. H. E. Marchbanks, M. D.

The Jour. of the Kansas Med. Soc. Feb. 1930.

Marchbanks summarizes his study thus:

The use of the electrocardiograph should become more general. There are many diseases of the heart that can not be recognized by physical and clinical examinations alone that should be diagnosed early by the aid of the electrocardiographic record.

Three types of myocardial changes are discussed with histories and electrocardiographic records of cases presented.

His conclusions are:

1. Auricular fibrillation can be definitely diagnosed by the use of the electrocardiograph in all but a few exceptional cases that must be differentiated from auricular flutter or paroxysmal tachycardia. It is granted that many of these cases can be diagnosed without the use of the instrument.

2. Angina pectoris and coronary disease can be diagnosed in most cases by the use of the electrocardiogram.

3. Records should be made from 5 to 30 or more days after the attack of angina pectoris before a negative report is taken as conclusive proof against coronary disease or before one says the record will not show the condition. Records are shown which tend to demonstrate this conclusion.

4. Bundle branch block is a common heart disease that is not diagnosed except by the most skillful without the aid of the electrocardiographic record.

5. Bundle branch block makes up about 10 per cent of all heart diseases seen in the author's private and hospital practice.

6. The electrocardiogram gives aid in diagnosis and prognosis in certain types of myocardial disease that is most satisfying to the clinician, and his patient.

Welche Behandlung Bietet Die Beste Heilungsaussicht Bein Melanosarkom? (Which Treatment Gives the Best Chance of Cure in Melanosarcoma?) Hans Holfelder.

Roentgenpraxis, 1929, ann. 1, No. 1 (March), P., 19-27.

Observations by the author as well as the experiences recorded in literature prove that in spite of the frank malignancy of melano-sarcomata there is indication of the therapeutic value of radiotherapy. Operative procedures greatly endanger the patients because of the dissemination of the tumor cells following surgical intervention. Neither is electrocoagulation better in this respect. Both methods have a value and must be resorted to in those melanosarcomata which originate in the skin. Operative

interferences for the melanosarcomata originating in mucous membranes or other tissues seem more risky. It is of importance that operative measures be directly followed by energetic radiotherapeutic procedures. But even in such melanoblastomas an operative intervention should only be undertaken from compulsory indication. Thus, it may be indicated in epibulbar naevus tumors of the eye in order to rid the visual field of encroaching growths. Similar urgent indications may be advocated in tumors which obstruct the air passages. In all these cases, however, the operative interference should be limited to the smallest possible extent, there being no need for including a wide margin of apparently healthy tissue in the excision. It must, however, be understood that radiotherapy plays the important part and that the aim of surgery is not the radical removal of the tumor, but only as a helpful measure. The principal point is always radiotherapy. Strong doses of a hard, deep radiotherapeutic irradiation have given the author the best results. It is to be noted that as a rule a sufficiently strong elimination of melanine by the urine following radiotherapy can be observed. According to Holfelder, deep roentgentherapy is the procedure of choice for melanosarcoma. By this means it is possible to obtain years of improvement, such as absence of recurrences in a notable percentage of cases and even permanent recovery in a certain number of cases. In the presence of a melanosarcoma the logical action should be to consult a radiotherapist before resolving on measures which would only uselessly endanger the patient.

Die Strahlenbehandlung Von Erkrankungen Des Herzens. (Radiotherapy of diseases of the heart). Leopold Freund.

Strahlenther., 1930, Bd. 36, H. 3, (May) p. 516-519.

Stenocardiac complaints of patients suffering from angina pectoris are benefited by radiotherapy. The most comfortable and suitable method of carrying out this therapy consists in the use of the mercury vapor quartz lamp. It seems that carbon arc light baths are not particularly fit for that purpose. In order to obtain an intense erythema, which is indispensable in order to achieve success, there would be but two alternatives: either the necessity of using very strong carbon arc lamps and approach the patients to the source of light, a procedure which is out of the question because the intense heat radiation and development of noxious gases intolerable for patients with severe cardiac diseases,—or the much simpler method of irradiation with the "alpine sun." It is advisable to combine a simultaneous irradiation by the Sollux-lamp or Nitro-Osrum-lamp. Most practitioners are nowadays possessed of both these irradiation apparatus, so that extensive use can be made of this therapy. The moderate annoyance of "sun burn" in no way compares with the favorable action on their stenocardiac difficulty. The effect of the irradiation is explained by congestion of the cutaneous vessels. The author, however, thinks that probably other effects are involved therein.

Eine Neue Ultraviolett-Lichtwaermequelle: Die Vitalux-Lampe Der Osramgesellschaft, Berlin. (A New Source of Ultraviolet Light: The Vitalux-Lamp of the Osram-Gesellschaft, Berlin). Fritz Kraus.

Med. Klinik, 1929, ann. 25, Nr. 46 (Nov.) P. 1707-1708.

To increase the intensity of the radiation as much as possible, incandescent lamps of high candle-power from 2,000 to 3,000 candles are used. Examples of such lamps are the Sollux-lamp of the Quarzlampengesellschaft, Hanau, and the Spectrosol-lamp of the firm of Siemens. The new vitalux-lamp also belongs to these incandescent light radiators. The body of this lamp is, however, made of a type of glass which is permeable to ultraviolet rays; it therefore occupies a medium position between the pure ultraviolet radiation of the artificial sun of the Quarzlampengesellschaft, Hanau, and the various type of the carbon arc lamps; these latter types are restricted in their popularity because of the high cost of operating. The principal advantage of the new lamp is its non-irritative properties on the human system. One is enabled, therefore, to make use of this lamp in the treatment of many acute conditions of nerves, muscles and joints — conditions wherein active therapy by other devices is obviously impossible. The author recommends the Vitalux-lamp in all acute neuralgias, neuritides (sciatica), acute muscular rheumatism (torticollis), although not with the same obvious success as in the chronic conditions of similar kind. In these latter conditions the author often saw permanent success due to the combination of diathermy with Vitalux irradiations.

Histologische Und Elastometrische Untersuchungen Ueber Die Wirkung Lokaler Hautmassage. (Histological and elastometrical inquiries into the action of local massage of the skin). A. M. Memmesheimer.

Dermat. Ztschr., 1929, Bd. 55, p. 105-115.

Exact chemical investigations showed a marked increase in dry residue in human skin of the aged due to increasing dehydration of the ageing tissues. This dehydration also holds for tissue with as rich a blood supply as is the subcutaneous connective tissue. The author succeeded in obtaining vascular dilatation of both the chorion and epidermis by massage. This stood out particularly strong and distinct when the massage was especially done with Amorskin. The intercellular spaces of the epidermis filled better, and the connective tissue bundles of the chorion thickened and became thus more taut and elastic. The skin was quilted to a great distance by the appearance of numerous cells in the chorion and the migration of cells into the epidermis. The cosmetic effect desired in ageing skin was consequently attained by massage of the skin in a very great measure, without lesions of any kind being thus provoked. The frictions with Amorskin was without irritation to the skin even when employed for months.

Fortschritte In Der Strahlenbehandlung Der Tuberkulose. (Advances in Radiation Treatment of Tuberculosis). A Bacmeister.

Fortschr. d. Ther., 1930, Jg. 6, H. 4 (Feb.), p 104-109.

All progressive forms of pulmonary tuberculosis, especially the early exudative processes, respond poorly to any strong radiation treatment. The stationary, productive types, however, and those tending to latency respond better to local irritation. Scar tissue formation is promoted by accurately graded focal reactions, but here, also, a certain limit ought not to be exceeded. Apical tuberculosis responds well to radiation treatment. Account should also be taken of the climatic influence on the patient, together with its train of irritative factors. The proper effect of light therapy still continues to be a controversial problem. Short wave radiation, from the violet and ultraviolet regions, is known to be absorbed in the skin and to penetrate only to a slight depth. Their effect is, therefore, mainly an indirect one, brought about by energy absorption in the skin. The yellow, red and part of the infra-red rays on the contrary possess a substantially deeper action. Therefore, the entire solar spectrum, and not any one kind of rays must be considered as the therapeutic agent. Sunlight treatment of pulmonary tuberculosis is not an indifferent remedy, since the foci can be stimulated directly towards progression; this is especially true in the fresh and early exudative infiltrations and the fresh exudative processes.

Quartz lamp irradiations exert a favorable effect by stimulating the skin function and the activation of certain known vitamins. But when use is made of this type of light there is the possibility of local irritation of pulmonary foci. The author points out in this connection, that the ever increasing abuse of quartz lamp irradiation for pulmonary phthisis at home by lay persons has become dangerous. Contrary to the aforesaid forms of radiation treatment, x-ray therapy for pulmonary tuberculosis attacks the tuberculous foci in a direct way. Only stationary forms of cirrhotic and nodular tuberculosis, and those tending to latency are suitable for x-ray treatment. Cavities within such processes are no contraindication. The exudative, and caseous and all changing productive forms should be excluded from roentgen ray treatment. On the basis of this, infantile tuberculosis in general is not suitable for x-ray treatment.

Die Erfolge Der Roentgenbestrahlung Bei Den Erkrankungen Der Druesen Im Kindesalter. (The Results of Roentgen Ray Irradiation in Diseases of Lymph Nodes in Childhood). Johann Lorenz.

Zeitschr. F. Arztl. Fortbild, 1929. Ann. 26. Nr. 10 (May) 213-314.

At least 90 per cent of the advantages of irradiation rests on the painless effect, bloodless method, good cosmetic result and rarity of recurrences. A drawback of irradiation is the impossibility of occasionally preventing purulent discharge. One must therefore in such instances seek surgical interference. When liquifaction occurs in the tissue of the lymph nodes, which is recognizable by increased tenderness, tension and redness of the skin and finally by fluctuation, stab incisions or preferably punctures will suffice. The author distinguishes three stages of tuberculous lymphomata. The first stage is characterized by purely hyperplastic forms, histologically due to granulation tissue. The second stage shows neoformation of connective tissue representing the stage of repair. The third stage consists of caseation and wasting. In both of the first stages irradiation is only given by divided doses. For individual lymph nodes, or smaller lymph node, packets light filters, preferably 3 mm. Al., in cases of large packets rather heavy filters, 0, 5 mm. Zn or Cu, are used, which produces better depth effect and spares the skin. The maximum dosage given in one sitting is up to one-third of the skin unit dose. In the third stage, irradiation with likewise reduced dosage can be continued, if no tension of the skin occurs, or if the tissue is surgically incised. The favorable results are maintained when irradiation is continued after fistulae have formed. Lorenz calls attention to some unfavorable complications: production of pain about the irradiated region, dryness of the mouth, pain in the jaws and occurence of painfulness of the irradiated area, also of a rise of temperature some hours or days after the irradiation. That is either a reaction on the part of the irradiated lymph nodes due to local congestion and tension of the capsule or to the simultaneous irradiation of healthy adjacent tsisue, e. g., the sublingual ganglia. It is unavoidable, and only transitory.

Behandlung Des Ulcus Ventriculi (Duodeni) Mit Kuenstlicher Hoehensonne. (Treatment of gastric (duodenal) ulcer by artificial sun). S. Plaschkes.

Ztschr. f. d. ges. physik. Ther., 1930, Bd. 38, H. 4, (Febr.) p. 117-123.

Irritative local ultraviolet light irradiation (artificial sun) has been demonstrated by the author to be a comfortable and very efficient method for the treatment of ulcer pain, or for the prevention of the periodic return of pain. The author endeavors to explain this empirically established fact by assuming the irritative irradiation of the skin to cause a hyperemia of the skin which, in turn, leads to reflex hyperemia of the internal organs—the soothing factor. The author advances the explanation that the treatment has a more specific influence on the inflammatory processes than on the spasm itself. It is probable that the treatment suggested by the author, if continued for some length of time, may also constitute a good remedy for gastric (duodenal) ulcer. It was observed that hyperemia and application of heat produced inhibition of peristalsis and consequently of the secretion of the stomach and bowels. A qualitative change of the secretion ensuing therefrom was demonstrated.

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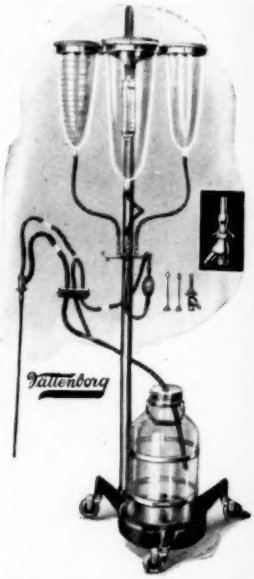

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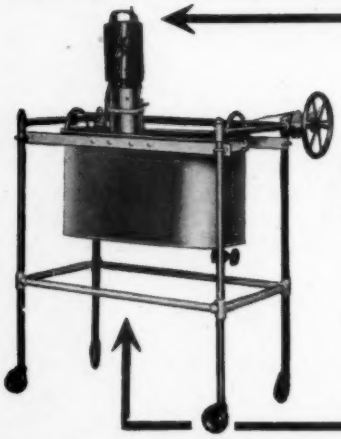

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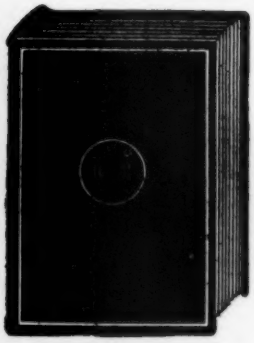

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